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ASSOCIATED FORMS OF INTERNAL BROWNING OF POTATO TUBERS IN NORTHERN INDIANA[1,2]

A. R. WOLCOTT[3] AND N. K. ELLIS[4]

Internal browning of potato tubers has been increasing in incidence and severity over a period of years on muck and sandy soils in northern Indiana. Several distinct patterns of browning have been recognized. Among these are forms which correspond to reported descriptions of internal brown spot (6, 7, 8, 9, 13, 14), heart necrosis (3, 19), corky ring spot or sprain (1, 4, 17), and canker type internal rust spot (2, 10).

Internal brown spot is considered to be physiological in origin and is commonly associated with drought or high temperature (9, 13). Heart necrosis has not been described, as such, in the United States. It may be a varietal expression of, or a more severe form of, internal brown spot, corresponding to the blotchy forms of physiological internal necrosis described in this country (5, 13). Some Italian data have been interpreted as indicating that heart necrosis is caused by virus infection (3).

Corky ring spot (sprain) is believed to be caused by a soil-borne virus which enters the tuber through lenticels or epidermal punctures (1, 18), although Grieve (11) was unable to demonstrate this mode of transmission experimentally.

Canker type internal rust spot apparently has not been reported in this country. There are some indications that the cankers may be bacterial in origin (10, 11). Moore (16) has questioned whether the canker type necrosis is distinctly different from sprain, since both types of injury are found in Great Britain on droughty soils, and both symptoms are not uncommonly found in the same tuber.

Reports of the intergrading of two or more types of internal browning in the same tuber or lot of tubers are infrequent (9). This fact has contributed to the common belief that the several types or patterns of necrosis represent distinct maladies with different etiologies.

During two seasons (1953, 1954), symptoms identical with or closely resembling two or more of the above four types of browning were frequently found together in lots of potatoes, individual hills and individual tubers grown in field and experimental plantings in northern Indiana. A brief report of these observations has been made (21). The present paper reports the observed relationships in more detail.

METHODS

In 1953, in an attempt to ascertain the time of onset of necrotic symptoms, four hills per plot from duplicate plots and two dates of planting of twenty standard potato varieties and seedling lines were harvested at intervals throughout the season. Tubers were cut in quarters and examined for necrotic symptoms. In 1954 similar periodic observations

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[2]These investigations were supported in part by a grant-in-aid from the Wm. Gehring Farms, Rensselaer, Indiana, and by fellowship funds of the National Science Foundation, Washington, D. C.
Journal Paper 993. Purdue University Agr. Experiment Station, Purdue University, Lafayette, Ind.
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were made on experimental and field plantings of several representative varieties. In the field surveys, random five-hill samples were taken in such a way that successive samplings comprised hills adjacent to previous samplings. Both seasons, after harvest of experimental plantings, 50-tuber samples were cut from each plot and classified according to type and severity of necrosis. Quantitative data from these experiments are reported elsewhere (*22*).

Types of Internal Browning and Observed Relationships between Them

In figure 1 are assembled tubers of Ontario, Chippewa, Kennebec and Sebago which illustrate the four types of browning encountered and some of the relationships which were observed between them. The top row of tubers shows, in sequence from left to right, an increasing aggregation of necrotic lesions to form large blotches. Associated with this aggregation of corky tissue is a distinct tendency for the injury to be restricted to local areas. Frequently, necrosis was confined to a large, concentrated lesion in the central pith, as in the heart necrosis described by Rothmaler (*19*).

In the middle row of figure 1 are shown tubers with severe corky ring spot. With increasing severity, the ring patterns lose their distinctness, as in the tubers at the right, by the convergence of several systems of rings, as described by Atanasoff (*1*).

The bottom row of tubers in figure 1, shows a type of necrosis which conforms to the descriptions of canker type internal rust spot as it is recognized in Europe (*2, 10*). It is characterized by the development at or about harvest time of small (1 to 3 mm.), reddish brown, corky lesions, randomly scattered through the interior of the tuber. Unlike internal brown spot, these granules of corky tissue break down centrally to form small cavities, spherical in shape, except as the coalescence of two or more adjoining cavities gives rise to irregularity in outline. The cavities are frequently isolated within the tuber tissues, with no channels or necrotic extensions leading to other cavities or to the surface of the tuber. In lots of potatoes where corky ring spot and canker type necrosis were found together, an occasional tuber would show a combination of both symptoms, as in the third tuber from the left. In Great Britain, it is reported that frequently the initial brown spots are barely visible at harvest time, but they increase in size and break down to form cavities during the first few weeks in storage.

In periodic samplings, it was found that diffuse flecking characteristic of mild internal brown spot was the first symptom to appear during the season. This was found soon after tubers had begun to enlarge rapidly, — late July to early September, depending on variety, season, soil type and planting date (*22*). The appearance of concentrated blotches, including the central lesions of heart necrosis, came somewhat later and was associated with larger and presumably older tubers. The distribution of browning in laced Ontario tubers in figure *2* shows a distinct tendency for localization of injury in the central pith in the older basal tubers.

The diffuse to blotchy patterns of internal brown spot and heart necrosis developed while foliage was still green and vines were in a vigorously growing condition. Corky ring spot symptoms showed up later

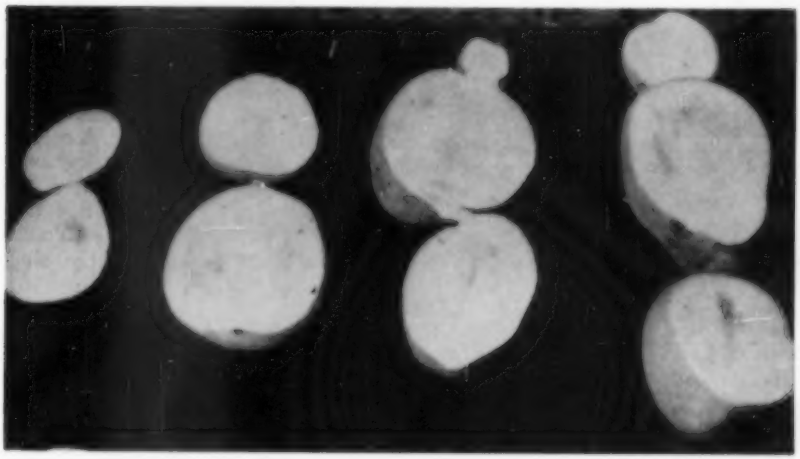

FIGURE 1.—Sectioned potato tubers showing four types of internal browning encountered on muck and sandy soils in northern Indiana: Upper row, internal brown spot grading into heart necrosis at the right; middle row, corky ring spot; bottom row, internal rust spot of the canker type.

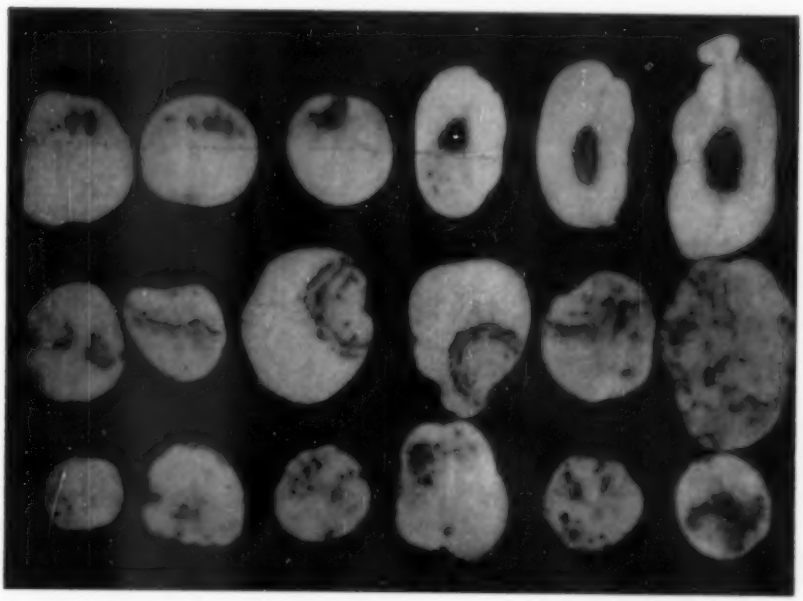

FIGURE 2.—Laced tubers of Ontario grown on fine sandy loam. Younger tubers at top show no internal browning. Intermediate tubers show diffuse, scattered flecking typical of mild internal brown spot. Older basal tubers show tendency to concentration and localization of necrosis in central pith.

in the season and usually were not detected until vines had begun to turn color perceptibly. Canker type lesions were never found in tubers attached to living plants. Whenever this type of injury was found in the field, the vines had matured and had been dead for ten days or longer. The small corky lesions which developed late in the season in association with the cankers were larger and more intensely colored than the minute flecks of mild internal brown spot which developed early in the season. Both were similar in the irregularly random distribution of injury throughout the internal flesh of the tuber. In this they differed from the localization of injury associated with the blotchy patterns of severe internal brown spot and heart necrosis or the rings and streaks of corky ring spot.

The sequential occurrence of the different types of browning is brought out by representative data from the 1954 field surveys, presented in table 1. The appearance of new necrotic symptoms at different times during the season coincided with periods of rising temperature or improved moisture supply (22). The fact that injury assumed a different pattern

TABLE 1.—*Seasonal development of different types of internal browning in field plantings of several potato varieties on the Wm. Gehring Farms, Rensselaer, Indiana. Data from periodic field surveys made in 1954.*

Location and soil Characteristics	Potato Variety	Date Observed	Type of Necrosis (1)	Necrotic Index (2)
Knoezer field: Sandy loam, pH 5.7, over compact clay at 24 to 30 inches	Ontario	8-5	IBS	trace
		8-31	IBS	4
		9-4	IBS	12
		9-13	IBS + CR	20
		10-16	IBS + CR	22
	Sebago	9-4	IBS	trace
		9-13	IBS + HN	23
East 85 acres: Deep gravelly sand, pH 6.6	Chippewa (3)	8-6	IBS	trace
		9-3	IBS + CR	20
		9-13	IBS + CR + CT	69
		10-1	IBS + CR + CT	50
East 30 acres: Black muck, pH 5.3, over deep fibrous peat	Katahdin (4)	9-3	None	
		10-10	No numerical classification was made, but corky ring spot was sufficiently severe to interfere seriously with the pack.	

(1) Types of necrosis: IBS = internal brown spot.
HN = heart necrosis.
CR = corky ring spot.
CT = canker type internal rust spot.

(2) Necrotic index = weighted percentage based on incidence and severity of necrosis in replicated 5-hill samples, calculated in the manner of Larson and Albert (13). No distinction was made between types of necrosis. Four severity classes were recognized: None, slight, moderate and severe.

(3) Chippewa vines were dead or dying on this area on Sept. 3.

(4) This was a late planting of Katahdins. Vines were still green and vigorous when checked by a light frost on Sept. 23.

FIGURE 3.—Ontario tubers from 1954 experimental planting on shallow, sandy muck with high water table and high nitrogen. Corky ring spot was associated with internal brown spot in twenty of twenty-four varieties and seedling lines tested on this area during 1953 and 1954.

at successive stages in the development of the crop appears to account for the fact that two or more types of browning were frequently found in a given 50-tuber sample of potatoes cut after harvest.

The types of browning most frequently found together in sample lots of tubers were corky ring spot and internal brown spot (Figure 3). Certain varieties, such as Triumph, Pontiac and Russet Burbank, showed a consistent tendency to develop a preponderance of corky ring spot over internal brown spot. A few, notably Irish Cobbler, Russet Rural and several seedling lines, developed little or no corky ring spot, but in most of these the incidence of internal brown spot was also low.

Heart necrosis symptoms were confined to the larger tubers of lots affected with internal brown spot and were most frequently found in field and experimental plantings of Sebago and Russet Burbank.

Cankers were observed only in 1954. They were associated with both internal brown spot and corky ring spot as shown in figures 4 through 6. They were found at harvest time or shortly afterward in Chippewa, Kennebec and two seedling lines. None was detected in Ontario at this time, but they were found in Ontario tubers affected with corky ring spot after five months of storage (Figure 7).

DISCUSSION

Four distinct patterns of necrotic internal browning were intimately associated in many of the varieties studied. The simultaneous occurrence of these types in the same sample lots of potatoes, and even in the same hills and tubers, together with their sequential appearance through the season, suggest that they may have a common etiology. Whether the primary causal agent is pathogenic or physiological may be open to

controversy. It does appear that physiological responses to climatic fluctuations strongly influence the development of the different symptoms and may actually represent a primary mechanism capable of producing any of these types of internal browning (22).

Potato tubers do not develop and mature as homogenous tissues. The physiological age of various tissues or regions within the tuber at different stages of growth could reasonably affect the distribution of morphological changes which might result from a given metabolic derangement imposed by physical or pathological factors in the external or internal environment of the plant. For example, small, young tubers

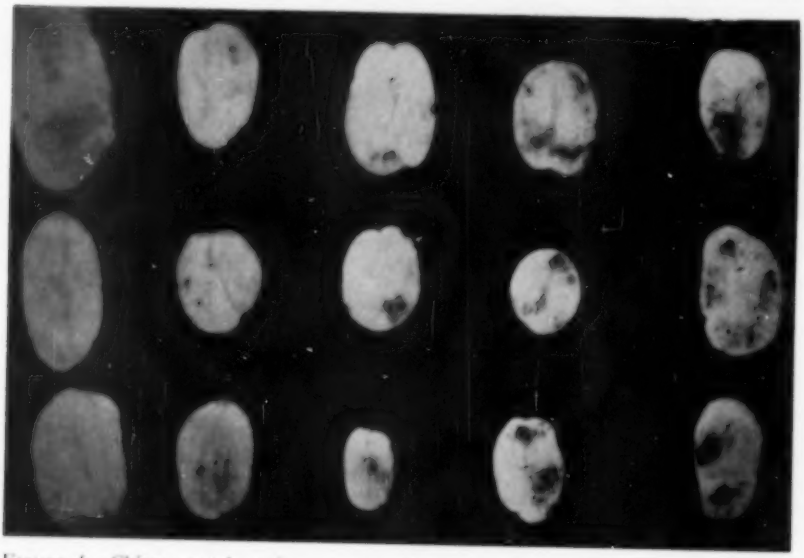

FIGURE 4.—Chippewa tubers from a gravelly sand area of 2½ acres. Picture taken mid-September of 1954, after vines had been dead two weeks. The six tubers at left show diffuse flecking and small blotches of internal brown spot. The remaining nine tubers show varying degrees of necrosis with cavities typical of canker type internal rust spot.

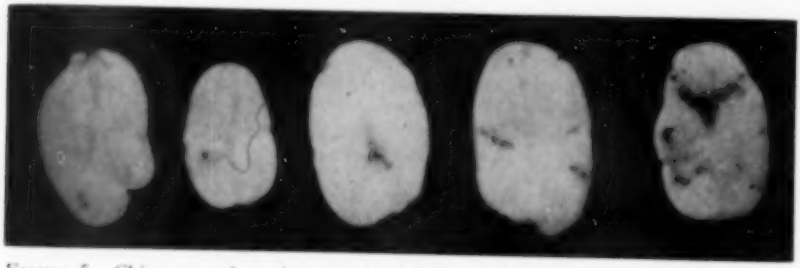

FIGURE 5.—Chippewa tubers from a single hill on the gravelly sand area of figure 4. Symptoms include scattered minute flecks and small blotches in the two tubers on the left, streaks similar to corky ring spot in the middle tubers, and severe spots and blotches with cankers in the tuber at the right.

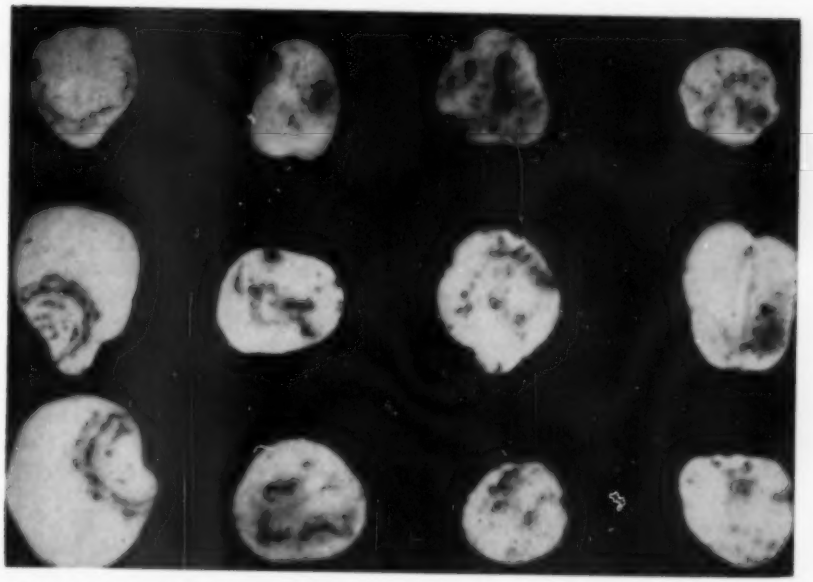

FIGURE 6.—The three tubers at the left are Ontarios with typical corky ring spot. The others are Kennebecs, showing ring patterns which become progressivley smaller from left to right. With decreasing diameter of rings, there is an increasing tendency for encircled tissues to break down and form cavities.

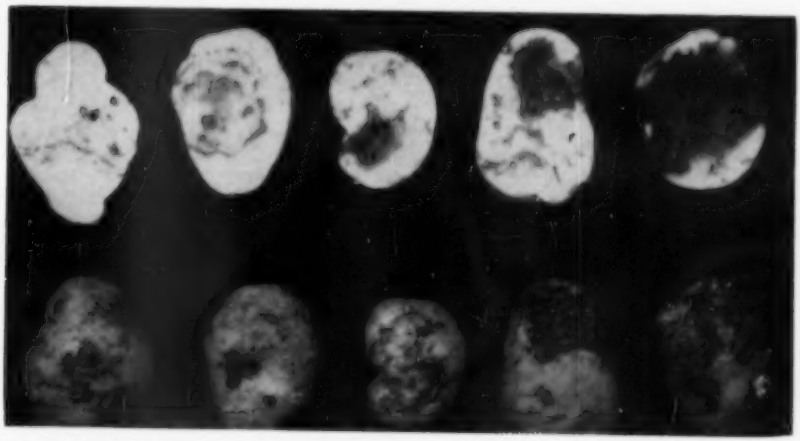

FIGURE 7.—Inside and outside views of Ontario tubers with corky ring spot and cankers after five months in storage. Extension of necrosis and cankers appeared to be arrested in the two tubers at the left. Active break-down and shriveling in the remaining tubers were due to decay organisms which entered through cracks formed where arcs of corky ring spot abutted the surface of the tuber. Such a sequence was described by Atanasoff for corky ring spot tubers which were immature at the time of going into storage (1).

appear to be less susceptible to internal brown spot than larger tubers, or those more differentiated morphologically (8, 13). This is shown graphically by the laced Ontario tubers in figure 2. In this study and others (7, 9, 13) internal brown spot symptoms have been found to develop during the period of rapid tuber enlargement.

In the present work, the clumping of small necrotic flecks to form large blotches was associated with the larger tubers. In larger (older) tubers, tissue differentiation would be more advanced, resulting in greater variation in physiological age or dominant metabolic function in different regions of the tuber. Such normal modifications in tissue metabolism might well alter the susceptibility of different tissues and account for the observed restriction of necrosis to localized areas in the more severe forms of internal brown spot and in heart necrosis.

Roughness and knobby second growth frequently occur in lots of potatoes affected with corky ring spot (sprain) (1, 17). This was observed in the present studies as shown in figures 1 and 7. Knobbiness and roughness of tubers are the result of differential growth in different regions of the tuber, and are promoted by fluctuations in the growth environment as tubers are approaching maturity (20). Metabolic gradients between regions of different dominant physiology might account for the distribution of necrotic lesions in rings and streaks in corky ring spot, or the symptoms may develop along lines of stress set up by differential growth in various parts of the tuber. These symptoms were first observed in the field late in the season and at a time when vines showed signs of maturing.

Canker formation appears to be associated with a later stage of physiological development than is the formation of corky ring spot. A distinct developmental relationship appears to exist between these two patterns of necrosis. In the Kennebec variety, corky ring spot frequently took the form of complete circles (or spheres) of necrotic tissue, ranging downward to rings of very small diameter. With decreasing ring diameter there was an increasing tendency for the encircled tissues to break down and form cavities as shown in figure 6. The frequent association of these two types of symptoms has been reported previously (16). The development of cankers in immature corky ring spot tubers during storage has been reported (1) and was observed here (Figure 7).

The formation of cankers is apparently associated with a period when metabolic adjustments are being made which lead to the establishment of dormancy in the mature tuber. That dormancy confers resistance to further extension of necrotic symptoms is indicated by numerous reports that internal brown spot, heart necrosis and corky ring spot do not increase appreciably in storage (1, 3, 8, 9, 13). Although canker formation does take place in storage, the maximum development occurs during the first few weeks after harvest (1, 10). Cankerous tubers from the 1954 crop showed no evidence of active necrosis or tissue breakdown after five-months' storage, — except where invasion by decay organisms occurred through surface cracks in tubers with severe corky ring spot (Figure 7).

The general proposition that the physiological age of tuber tissues may determine the nature of morphological changes in response to a given stimulus finds support in the studies of Levitt (15) and of Krantz

and Lana (12) on hollow heart. These complementary studies indicated that hollow heart has its origin in a small necrotic lesion which develops in the central pith of the very young tuber. Levitt's photomicrographs of these initiating lesions reveal the same structure as those of Larson and Albert (13) for internal brown spot. Krantz and Lana found that defoliating the plants at the time of first tuber set increased the incidence of hollow heart, whereas shading the plants at this time reduced this symptom. Defoliating or shading treatments at later stages of growth had no effect.

Summary

In periodic samplings of potato tubers through the season, diffuse to blotchy internal brown spot and heart necrosis symptoms were found to appear during the period of rapid tuber enlargement while the vines were still green and vigorous. Injury observed as vines were turning color was of the corky ring spot type and was associated with roughness and knobby second growth in the same lots of potatoes. After the vines were dead, necrosis with scattered cavities was found of a form described in Europe as internal rust spot of the canker type. Two or more of these types of necrotic internal browning were found in intimate association in sample lots of most varieties studied. It is suggested that these types are related in origin but differ in pattern as a result of differences in physiological age of tuber tissues at the time that injury occurs.

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STUDIES ON THE STORAGE STABILITY OF C-VITAMIN IN POTATO GRANULES AT VARIOUS MOISTURE LEVELS[1]

E. KISSMEYER-NIELSEN[2]

INTRODUCTION

Potatoes are one of the important sources of C-vitamin. The C-vitamin content of potato granules decreases during storage. It is desirable to maintain the C-vitamin content in potato granules at a high level. This investigation was carried out in order to investigate the influence of the moisture content of the potato granules on the storage stability of C-vitamin.

MATERIALS AND METHODS

The potato granules for this experiment were manufactured in a pilot plant designed as an ordinary commercial potato granule plant. Only the fraction sifted through a U.S. No. 50 screen was used for the tests. Ascorbic acid diluted in water was added to the potatoes previous to drying. The total C-vitamin content was 810 ppm., bone dry basis right after drying. The SO_2 content was 324 ppm. bone dry basis. Three samples of 200 grams each, in beakers, were placed in three desiccators. The humidity of the air in each desiccator was controlled in such a way that the moisture of the samples soon after the start of the test reached 11, 13 and 15 per cent respectively. The C-vitamin determinations were carried out as follows: 2 grams of potato granules were ground with 10 grams granulated quartz and approximately 10 cc 0.3-n HCl. This slurry is rinsed down in a 50 cc centrifuge glass with 0.3-n HCl until the glass is full. The liquid was centrifuged for approximately 5 minutes at 3000 rpm. The clear liquid was decanted and the precipitate stirred up with 0.3-n HCl and centrifuged for approximately 10 minutes at 3000 rpm. This was then repeated. The decanted liquid was diluted with distilled water to a total of 150 cc. Two samples of 25 cc. each were pipetted out and titrated with the following titrate: 100 mgs. Diclorofenolindofenol is dissolved in 20 cc. phosphate buffer (Sorensen) with pH 6.98. Dilute to 100 cc. with redistilled water, heat until rolling boil and filtrate. Control with a 5 mls. solution of 10 mgs. ascorbic acid in 250 mls. 0.3-n HCl.

RESULTS

Table 1 shows that the C-vitamin content of the potato granules at the end of the test is 17 per cent higher in the sample with 11 per cent moisture than in the sample with 15 per cent moisture. This is quite a significant difference and it indicates that the moisture content of the potato granules is of major importance for the preservation of the C-vitamin.

DISCUSSION

R. L. Olson and coworkers have pointed out (Journal Soc. Chem. Ind. 64:215-8 (1945) and 68:149 (1949) that off-odors and off-flavors of potato granules increase with lower content of moisture. Bearing this

[1]Accepted for publication May 1, 1956.

[2]Assistant manager, potato starch and potato granule factory, Olsted, Denmark.

TABLE 1.—*Effect of moisture content of potato granules on storage stability of C-vitamin. Storage temperature, 25° C.*

Date	11 per cent H_2O		13 per cent H_2O		15 per cent H_2O	
	Ppm. C-vit.	Per cent C-vit.	Ppm. C-vit.	Per cent C-vit.	Ppm. C-vit.	Per cent C-vit.
5/27/55	810	100	810	100	810	100
6/28/55	590	73	480	59	480	59
7/29/55	470	58	430	53	330	41

in mind a preliminary investigation of the influence of packing in inert gas was carried out. Nitrogen was used for the test. Potato granules were placed in test tubes that were placed in vacuum and filled with nitrogen several times. The glass tubes were melted air-tight immediately after this operation. Only a few of these samples have been tested so far but there is a definite indication that this type of packing greatly retards the decline of C-vitamin in potato granules during storage. It is widely known that this type of packing prolongs the storage life of potato granules greatly.

C-vitamin is one of the most important constituents of potatoes and one which is greatly needed in areas where it is hard or impossible to get fresh potatoes and where it is difficult to get other foods high in C-vitamin. This is especially where potato granules have a mission and the reason why it is so important to secure or increase the C-vitamin content of potato granules.

NEWS AND REVIEWS

POTATO GROWING IN PERU[1]

E. C. REID[2]

"Professor Vargas, just what is the highest point at which you have collected native potato species in Peru?" I recently asked the scholarly head of the botany department of the University of Cuzco, located in the old capital city of the once mighty Inca Empire.

Satisfying a life-long ambition, I had flown some 7,000 miles to visit the original home of the potato and to talk with this internationally known botanist whose research work in the classification of native species had brought him high recognition in potato circles around the world.

Despite my inadequate Spanish, the Peruvian professor and I got along surprisingly well. Now here we were, two potato enthusiasts one from each side of the equator, discussing our favorite topic. At his insistance I had come to his home after office hours and in his study that still showed the effects of the earthquake that shook Cuzco in 1951, I was going over his well-mounted herbarium specimens and with the aid of a map studying some of the regions in which he had made his collections.

"Well," the professor remarked reflectively in reply to my last question," as you know we compute elevations down here in meters, but by using your system of measurement, it is safe to say that some of my collections made north of Lake Titicaca near Macusani, would be approximately at 15,000 feet."

In Canada and the United States we just can't feature any farm crop growing at 15,000 feet (approximately 2½ miles straight up) above sea level, but down in Peru almost anything can happen. I discovered this before the end of my three weeks' holiday trip. Along the shores of Lake Titicaca for instance, at an elevation of 12,500 feet there is quite a thriving potato growing industry.

You may call it a skyline crop if you like, but historians agree fairly well that the Peruvian's initial success in winning a footing on the inhospitable Andean highlands, centuries before Columbus discovered America, may be attributed to the successful cultivation of the potato at these (to us) fantastic heights. Some historians go even further and claim that without the potato as their basic food, the Incas might never have succeeded in building an empire or establishing a civilization that has been the subject of man's wonder and amazement for centuries.

RESEARCH AT LAKE TITICACA

Long before the Spanish Conquest, the silent patient sons of the Peruvian soil had laboriously produced their potato crops high on the bleak, semi-barren slopes of the Andes under conditions that at times must have defied nature. Doggedly, persistently through the years these intelligent potato men eventually selected native species that could stand up successfully against nature's climatic whims and such diseases and

[1]Accepted for publication July 20, 1956.
Contribution No. 118 from Plant Protection Division, Production Service, Canada Department of Agriculture, Ottawa, Ontario, Canada.
[2]Plant Protection Officer, Plant Protection Division, Edmonton, Alberta, Canada.

insects that were native to the regions concerned. And today potato growers throughout the world can be thankful that these Peruvian pioneers were in part at least successful in their quest, since "Andean bloodlines" play an important part in modern potato breeding.

Apparently no one knows positively, but it is generally agreed (except by the Russians perhaps) that the ancestor of our present humble spud originated in the region around Lake Titicaca. Here as we have seen, the Indians carry on a potato growing industry. It may be poetic justice, or simply the right combination of men and climate, but Puno on the shores of Lake Titicaca is being considered at the present time by officials of the Peruvian ministry of agriculture as one of the best foundation seed-producing areas in the country.

By selection, breeding, and by the extensive use of test plots in special areas the "Ministerio de Agricultura" in Peru has a realistic modern potato improvement program underway that is aimed at improving and stabilizing the potato-growing industry in the republic. There, too, a few miles out of Puno at the Experimental Station overlooking the historic and beautiful Lake Titicaca (Figure 1), the Department has set aside extensive plots for carrying on the national program in this area.

As in North America and elsewhere where potatoes are grown, each area has its specific problems and at Puno the agricultural officials have enlisted the aid of neighboring farmers to carry on additional tests that have a bearing on the local potato-growing industry. One test on an adjoining "Illustration Station" was of particular interest to this reporter as it showed the definite value of sprouted over unsprouted seed. I was told that cut seed was never planted in Peru, so I had to look for another explanation concerning an uneven stand I saw in one field.

A common rotation around Puno consists of potatoes, broad beans (this crop I found was widely grown in Peru) and a Chenopodium species (Quinoa) grown for seed that looked, for all the world, to me like lamb's quarters, one of our most common weeds. There was also a pink-topped species grown for seed. This particular species is also popular with the natives for making bread.

Late blight is sometimes a problem around Puno as elsewhere in Peru and extensive spray experiments have various chemicals under test, with Bordeaux holding its own apparently south of the equator as well as it does in the north. Soil fumigation is also getting its share of attention, too, for the control of the so-called Andean weevil that is peculiar to the high elevations in Peru; golden nematode is also a problem receiving attention from the "backroom boys" of the Ministry.

Potato Research in Peru

Any research program is only as good as the men who conduct it; and in Carlos Ochoa, who supervises the potato improvement program in Peru, the government has a well-trained, talented research man with the needed vision and initiative to see the program through that has been laid down by a sympathetic administration.

Directing the over-all agricultural policy, under the Minister, is Senor Jacobo Zender "General Secretario de Agricultura," a man of unusual charm, personality, and insight, whose presence would be a wel-

FIGURE 1.—Beautiful Lake Titicaca, elevation 12,500 feet, thought by many to be the cradle of the Inca race. Here too, the potato is supposed to have originated, being grown on such hillsides as these for centuries before Columbus discovered America.

come addition to any agricultural department, north or south of the equator.

You might say that Senor Ochoa, the Peruvian potato specialist, is a direct descendant of the Incas, being born in the old capital of Cuzco. Here he took his early schooling, with post graduate training in plant pathology in the United States. Since graduation he has been employed by the Department and has done considerable collecting of native species throughout the highlands of Peru. Some of this material is being tested at Puno with similar tests at Cuzco, Arequipa and Huancayo.

By rare good fortune at the time of my visit to Peru, Senor Ochoa was making the rounds of his plots, so I was able to accompany him and learn first hand something of the work being done at each station we visited. Also in our agricultural party were Dr. Fred. Cochran, horticulturist from the State College, Raleigh, North Carolina, on loan to P.C.E.A. (a cooperative agricultural experimental program in Peru) to advise and make recommendations on potato research there, and Ralph Cummings Jr., son of the director of the College. (Figure 2.)

TEST PLOTS IN THE LAND OF THE INCAS

I joined the party, or to be exact the agricultural officials met me in Cuzco on December 26. For personal reasons I wanted to spend Christmas in Cuzco and had flown in to the old Inca capital early in the morning, much impressed with my newly-acquired ability to chew gum

FIGURE 2.—Part of Professor Vargas' potato collection at the Experimental Station, Cuzco, in the heart of Inca land at about 11,500 feet. Senor Carlos Ochoa (left) with Dr. Fred. Cochran, U. S. potato specialist from the North Carolina State College, Raleigh, N. C.

and suck in oxygen in rhythmic combination as an antidote against altitude troubles.

Cuzco has an elevation of about 11,000 feet, just high enough I was told to suit the llamas, those amazing, proud creatures whose graceful movements on the skyline of the Andes was something to see and remember during my potato tour in the highlands of Peru. Some were seen when we were going out to see the potato plots at the Experimental Station on the outskirts of Cuzco where we made our first observations.

Among the extensive potato tests under way at this Station, one of particular interest to me, was a variety plot that included many selections from Professor Vargas' collection. These had been turned over to the Ministry for propagation and distribution and many were found to be in flower and showed great variation in vigor, habit of growth and resistance to disease.

"Chuno," the Peruvian term for potatoes dehydrated by a special freezing and washing process that has been in use by the Indians for centuries, has played an important part in the evolution of the Incas and those who have followed after. Through the years certain varieties have been found particularly well suited for this purpose and two of these were seen at the Cuzco Station, *Solanum juzepczukii* and *S. ruki*.

Senor Ochoa also showed us some of his new inter-varietal and inter-species crosses that exhibited good vigor and general freedom from

disease. Casa Blanca, a promising new selection introduced by the Ministry, was seen in multiplication plots designed for further trial and distribution in Peru.

The soil for the most part around Cuzco is a fertile red loam of good depth, well suited to potato culture. During our stay in the area we visited a number of commercial fields, which were found to be in a good state of cultivation and comparatively free from disease. Most of the fields observed were about an acre in extent though we were told that one grower whom we were unable to visit had nearly 100 acres planted to the Alccai Huroni and Accompis varieties.

"One acre, two acres or 100, it all adds up to the same formula of hand labor for planting, cultivating and harvesting in Peru." That was how the potato production problem was summed up by Dr. Lester W. Snyder, agricultural engineer from the University of West Virginia, after he had spent several months studying labor and farming conditions there. Dr. Snyder was a technical expert on farm machinery on loan to S.C.I.P.A., an inter-American cooperative project organized to increase food production in Peru, whom I had the good fortune to meet while our potato fact-finding party was in Arequipa, in the southern part of the republic.

"Ari, quepay" or yes, let us stay a while, the natives used to say when they first saw Arequipa and it is not hard to understand why they felt that way once you have seen this oasis in the desert. Irrigation is needed for all crops and never perhaps have I seen such lush, green crops of corn and alfalfa as are grown in this area. The potato plots that we had come to see were scattered on the outskirts of the city. At this point all growth was found to be more advanced than any we had seen on our trip at this place the tops on January 3, filled the irrigated rows and the tubers were well formed on some varieties.

The varieties included Casa Blanca, Huasa Huasi and Girco, an old Indian variety under test that showed severe mosaic and purple top-wilt. A special trip was made to a commercial field that was just about ready for harvesting, where late blight on foliage and tubers was apparent as well as one of the wilt diseases. Yields appeared to be light, judged by North American standards.

Currently in Peru, there is considerable discussion and investigation going on concerning the possibility of establishing a potato breeding and distributing center on an international basis. The proposed plan would be to utilize not only the native species of solanum found in Peru, but those known to occur in other South American countries as well as in Central America.

Virus diseases and late blight are problems facing growers almost the world over and some scientists are beginning to realize that breeding for disease resistance against these and other diseases will be most effective only through cooperation on an international scale.

Potato research men in both South and Central America for some years now have on occasion been lending each other a helping hand in attacking some of their more pressing problems. Dr. John Niederhauser, potato specialist with the Rockefeller Foundation in Mexico City, is an acknowledged late blight authority and has been to Peru to confer with

officials there, who are troubled by this and other serious potato diseases. Early in the new year there was talk of a special potato conference or short course to convene in Lima where workers representing different institutions in the United States were expected to be in attendance together with those from the other Americas.

Who knows but plans made at this proposed conference may have far reaching effects on the humble spud, one of the world's main foods that originated as a skyline crop in the Andes centuries ago.

POTATO FLAKES, A NEW PRODUCT, SELL WELL IN TEST

Potato flakes, a new dehydrated product used in making mashed potatoes, sold well in a market test in a medium-sized city, and repeat purchases were sufficient to indicate that homemakers like them, the U. S. Department of Agriculture reports.

The flakes were developed by the Department's Eastern Utilization Research Branch, Agricultural Research Service. The market test was conducted by the Agricultural Marketing Service is cooperation with ARS, Maine State Department of Agriculture, Maine Agricultural Experiment Station, and Maine Potato Commission.

The marketing experiment was made in 41 super markets in the Triple City metropolitan area of Binghamton, Endicott, and Johnson City, N. Y., selected as fairly typical of medium-sized metropolitan areas in the region. The population was about 150,000 according to the 1950 census.

Between June 4 and 16, 1956, all 41 stores were stocked with the test product — State of Maine Potato Flakes. The price of the test product was set at a level commensurate with that of other instant-type potato products.

During the week of June 18, a 4-week advertising and promotion campaign was launched by the Maine Potato Commission through its advertising agency, in newspapers and on radio and television.

Records were obtained from 20 stores on the sales of potato flakes and 14 other competing products. A household survey was undertaken 6 weeks after introduction of the product on the market; the product had been sold out when the survey began. Three types of households were included in the sample: (1) Those who used the product within the last 6 weeks, (2) those who were aware of the product but did not use it, and (3) those who had not heard of the product. Among the sample households, every user of the product was interviewed.

A total of 894 cases of potato flakes, each containing 24 four-serving boxes, were sold during the 5-week market test period. This represents purchases by about 14 per cent of the households in the Triple City area. In-store demonstrations proved to be a powerful stimulant to sales. Demonstrations were held in 6 super markets for 2 consecutive weekends during the first 2 weeks of the market test. They accounted for an estimated two-thirds of the sales of the test product in the 2-week period. For the 5-week period, in-store demonstrations accounted for about 25 per cent of the sales in the 41 stores carrying the test product.

Sales of potato flakes during the final (5th) week had fallen off to about half of those during demonstration weeks During the 2 demonstration weeks, sales of potato flakes averaged 8.8 cases per store, audited. For the remainder of the test period, audit store sales averaged 4.3 cases, or about half the demonstration period volume. A dropoff in sales from a demonstration period to a nondemonstration period is not unusual. However, the dropoff for potato flakes was relatively low compared with those in previous market tests where sales after demonstration dropped to one-seventh or one-eighth of those in the demonstration sales period.

The data were adjusted to remove the effect of demonstration sales during the first 2 weeks, to give an idea of what the sales would be had there been no in-store demonstrations. When this is done, sales for the last 3 weeks of the market test show an upward trend. This would indicate that either new buyers were entering the market for this product or that initial buyers were making a considerable number of repeat purchases. Despite the short period involved and other limiting factors, the consumer survey bears out the latter contention, that a considerable proportion of initial buyers made repeat purchases. It was found that 6 of each 10 initial buyers made 2 or more purchases of the test product. This rate of repeat purchases is impressive in view of the short time the product was on the market. Moreover, 9 in 10 users of the product reported they would buy the product in the future if it were available.

Comparisons of sales were made between potato flakes, fresh potatoes, and other potato products on a fresh-potato basis. Only two products — fresh potatoes and potato chips — outsold flakes, by ratios of about 15 to 1 and 2 to 1, respectively. However, except for these two products, potato flakes sales, on a fresh equivalent basis, were at a rate greater than frozen french fried potatoes and far exceeded the sales of all other processed potato products.

Perhaps the most striking effect of the market test was the high rate of sales achieved initially and maintained during the market test period. There was general enthusiasm among the buyers of the product. This is borne out by the survey data: 88 per cent of homemakers who used potato flakes were generally satisfied with the product, 87 per cent were satisfied with its taste, and 83 per cent were satisfied with its texture.

POTATO HAIR SPROUT DISORDER OF POTATOES CAUSES PROBLEMS FOR PROCESSORS AND SEED PRODUCERS[1]

M. YAMAGUCHI[2], G. SEGELMAN[3], AND L. F. LIPPERT[3]

Hair Sprout, a disorder of potatoes that has been increasing in California during the past few years, is characterized by long thin sprouts produced by the tuber. The sprouts often produce small aerial tubers.

When used for seed, affected potatoes produce plants which are weak, small, and spindly. These plants fail entirely to produce or they form only small tubers, so the yield is greatly reduced.

ABNORMALITY STUDIED

Studies have shown that affected tubers respire significantly less than normal tubers. This might explain why tubers which produce only Hair Sprout seem to store better than tubers producing normal sprouts. Chemical analysis reveal that White Rose potatoes with Hair Sprouts were high in both reducing and nonreducing sugars. Normal potatoes had a content of 0.18 per cent reducing and 0.26 per cent total sugars while the abnormal tubers analyzed 0.55 per cent reducing and 1.15 per cent total sugars.

Tests also showed that abnormal tubers were lower in specific gravity than normal tubers from the same lot. In one lot of White Rose potatoes, 18 per cent showed Hair Sprouts when subsequently sprouted. Of these affected tubers 82 per cent had a specific gravity of less than 1.065, while only 26 per cent of the normal tubers fell in this range. By flotation in a brine solution of 1.065 specific gravity, the percentage of tubers showing this disorder could have been reduced to 5 per cent.

High sugars in potatoes are known to cause very dark-colored potato chips which are not acceptable. Potato chip producers have noted that in certain lots of potatoes a percentage often fry to a very dark color and, because they are not acceptable, must be removed manually from the production line, entailing additional expense in packaging. Normally the affected tubers cannot be detected before chipping because they have not sprouted. Part of the dark chip problem of processors may be caused by potatoes which would produce Hair Sprout.

Since potato chips constitute approximately 15 per cent of the total potato consumption in the United States, Hair Sprout has become a problem to the chipping industry as well as to the certified seed producers.

Hair Sprout has been observed in the United States since 1909, but it has not been related to a definite cause. It has been reported that certain potato diseases, such as Aster Yellows, and — in recent studies — gamma ray irradiation by use of atomic energy, can produce abnormal sprouts.

STUDIES CONTINUING

Field plot tests are being conducted to determine whether Hair Sprout can be caused by high soil temperatures, low soil moisture—or both. Biochemical studies also are being made to explain the high sugar content and abnormal respiratory pattern.

---

[1]Reprinted from California Agriculture, October, 1956.

[2]Assistant Olericulturist in Vegetable Crops, University of California, Davis.
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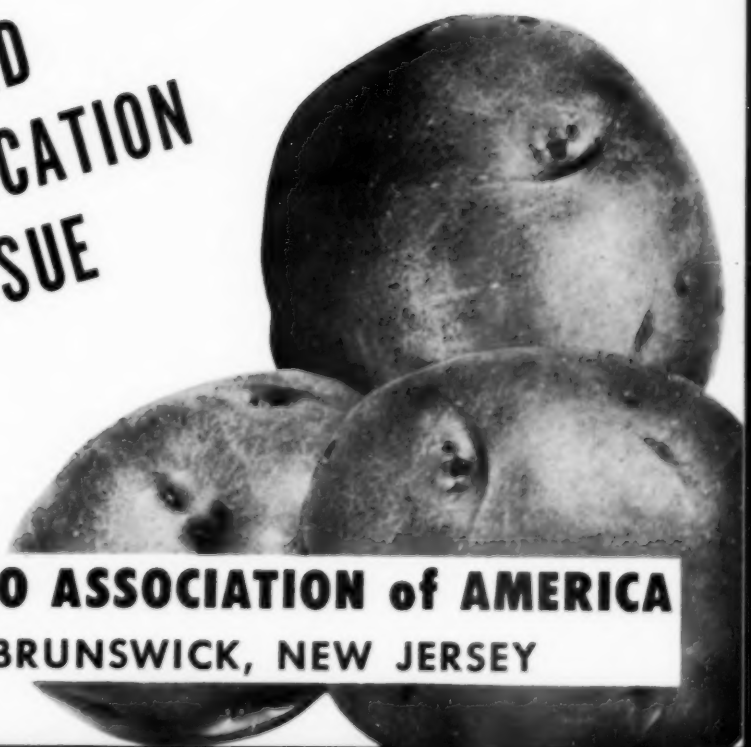

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THE PURPOSE OF CERTIFIED SEED POTATOES

To provide reliable sources of first-class seed potatoes, 30 States have established systems whereby potatoes may be inspected and given the stamp of approval. Inspection of fields and harvested crops can determine if the potatoes are reasonably free from disease, are true to name and type, and would otherwise make good seed. If they pass these inspections they are certified.

Standards for certification vary among States, but in general they are much the same. They all require that fields entered for certification be planted with seed that meets the approval of the certifying agency. Some of them require test samples of seed that the growers will plant. Most States have rules about the distance that certified fields must be from fields of table-stock potatoes. Some require that the grower maintain a seed plot for the maintenance and improvement of his own seed supply. Many States require that samples of seed be grown during the winter in the South to further prove their quality.

At least two field inspections must be made. These provide opportunity for detecting virus diseases, such as leaf roll, mosaic, and spindle tuber, and other diseases that may show in the vine but not in the tuber. They also reveal diseases, such as ring rot and yellow dwarf, that are evident in both vine and tuber.

Field inspection standards are set for the percentages of various diseases that will disqualify. Standards are stricter for the second inspection than for the first. Often growers will find it necessary to pull out (rogue) diseased plants in order to qualify their potatoes.

Bin and shipping inspections of tubers are required. These show whether the potatoes come up to standards for grade, packaging, and labeling.

A special tag is attached to each sack of certified seed. Tags used for the best grade are usually blue, or white lettered in blue. They carry the words "Certified seed potatoes," and the name of the certifying agency.

Potatoes that pass inspections of the State certification authorities are "seed potatoes." In the long run they can be counted on to give a much greater yield than ordinary table-stock potatoes.

PREFACE

The American Potato Handbook is being sponsored by the Potato Association of America as a supplement to the Potato Journal. In the Handbook will be found articles giving more practical information than would be possible throughout the year in the Journal. We have gathered this information in one issue as a readily accessible handbook, valuable to growers, dealers and others in the potato industry. There will still be popular articles in the News and Reviews section of the Journal but the wealth of everyday practical information will be concentrated in the Handbook.

This first issue is being devoted largely to certified seed and new potato varieties. Certainly certified seed is the foundation upon which much of the potato industry rests and for that reason it is entitled to special attention. Nothing else quite equals potato certification programs as an example of applied research. We hear a great deal about potato surpluses. Perhaps potato production has been too good, but good or bad, this abundance would not have occurred had it not been for research in disease and insect control, and for potato breeding and the development of new high yielding varieties. These things are all incorporated in the potato certification programs. Disease free seed doesn't just happen, it is the result of the efforts of a lot of people, working together. First, the researcher with his findings; then the seed grower putting the research to work and third, the certification official aiding the farmer, and from a neutral position, confirming the fact that the seed is of high quality. The major part of this accomplishment has happened in the last twenty-five years. It has been both gratifying and heartening to watch these programs develop over the years. When potato farmers become disease experts and use such terms as: leafroll, spindle tuber, rugose mosaic, and purple-top familiarly and with complete understanding; and furthermore learn to recognize these diseases in the field as keenly as the technical research man, and the certification official; then adult education, the Extension Service principal, has been accomplished with remarkable success. The above has been realized hundreds of times among the seed potato growers of America. They can truly stand on their merit.

Also the certification programs as conducted in America are the noblest examples of democracy at work. Largely grower controlled, honest beyond the fondest belief, sanitary as a modern hospital, they have brought about a form of quality and standardization entirely dependable. When the Blue Tag is seen today, regardless of from which state or province, it represents a good product. It represents disease freedom; it represents varietal purity; it represents good quality with definite size limitation. There are exceptions, but they are becoming so few as to be a rarity. Nowhere in American agriculture is pride of accomplishment more pronounced than in the certified seed potato production industry. These are some of the reasons why certified seed is being sponsored in this first issue.

It is the hope of the membership of the Potato Association of America that everyone interested in, or in any way dependent upon, the potato industry for a livelihood will get an opportunity to review this Handbook.

Higher paying potato crops can be yours if you use *Sul-Po-Mag*. This is indicated by many experiment station tests. For example, the use of 30 to 50 pounds per acre of soluble magnesium derived from *Sul-Po-Mag* has increased potato yield as much as *70 bushels* per acre. And the use of sulfate of potash has improved potato yields and raised starch content as much as 16%. These potatoes have better keeping qualities and are generally more acceptable to the retail trade and to buyers such as potato chip manufacturers who want especially high quality.

RAISE

POTATO YIELD

STARCH CONTENT

PROFITS

Sul-Po-Mag®

Water Soluble

Double Sulfate of Potash-Magnesia

($K_2SO_4 \cdot 2MgSO_4$) 22% K_2O–18% MgO

Many potato soils are acid and naturally low in magnesium — a plant food which is easily lost through leaching. And, too, as you use more potash to improve quality and yield, more magnesium is required to maintain the proper ratio between these important plant foods. Plants can make more efficient use of potash when they have enough magnesium. That's why quick-acting, water-soluble *Sul-Po-Mag* is so ideal for potatoes. It supplies *sulfate of magnesium* in balanced combination with *sulfate of potash*. You can get *Sul-Po-Mag* in many of the leading brands of potato fertilizers or bagged for direct application. So use *Sul-Po-Mag* now . . . it really pays!

POTASH DIVISION

INTERNATIONAL MINERALS & CHEMICAL CORP.

GENERAL OFFICES: 20 NORTH WACKER DRIVE, CHICAGO 6

EARLY HISTORY OF POTATO SEED CERTIFICATION IN NORTH AMERICA, 1913-1922

Edited for The Potato Association of America by
G. H. Rieman
University of Wisconsin

The certified potato seed industry in the United States and Canada has gradually increased in importance and recognition from a humble beginning in 1913, when 30 thousand bushels of seed potatoes were certified, to a current annual production of about 50 million bushels of certified seed valued at over 100 million dollars.

This has been one of the most brilliant examples of crop improvement on a continent-wide basis in the long history of agricultural development. The key to its present successful position rests on sound scientific principles established prior to and during its formative years by research men not only working in unusual close cooperation within the plant science disciplines but with practical potato specialists, potato growers and administrators of various public agencies. Truly, potato seed certification, as it is known today, represents a great cooperative effort on a national and international scale.

The pathways to this desirable state of affairs have not been easy. The voluminous literature records many heartbreaking reverses as well as keen successes. There remains much to be accomplished. The purpose of this brief review is to emphasize how some of the more perplexing problems of the early years of potato seed certification were handled with the hope that these pioneer contributions may lend some encouragement and guidance for present and future improvements.

National Plant Quarantine Established

The tremendous expansion of potato culture throughout the world during the last half of the nineteenth century was accompanied by the dissemination of many of the more serious pests of the potato plant. During this period potato seed stocks were freely exchanged on a world-wide basis and destructive diseases and insects moved with these stocks and became established in regions favorable to them causing famines in Europe and the elimination of the crop in other areas of the world. One of the first major steps taken to control the movement of pests of potato tubers from one country or continent to another was the National Plant Quarantine Act of 1912. This act prohibited the importation of potatoes from six European countries, Newfoundland, and two islands near Newfoundland where the destructive disease, potato black wart was known to occur. The embargo from countries where wart occurs has never been lifted and the disease has been effectively controlled in the United States although it has become established in small local areas.

A second disease, known as powdery scab, which had become serious in Europe was discovered in Canada in 1912 and in Maine in 1913. A federal quarantine was established in 1914 to protect the other sections of the United States that were still free from the trouble. This quarantine prohibited importations from Canada and other countries and shipments from infested areas within the United States except under a strict system of certification. It appears that this embargo of 1914 on Canadian potatoes because of powdery scab had much to do with the early establishment of an orderly system of potato seed inspection and certification in Canada. It should be noted that a few years'

WILLIAM ALLEN ORTON
1877-1930
Father of potato seed certification in the United States.

study demonstrated that climatic and other natural barriers were more effective than the most rigid quarantines in preventing the spread of this disease throughout the United States and the quarantine was lifted.

Seed Certification Developed

The international aspect and importance of disease dissemination by means of seed tubers was early recognized by Dr. L. R. Jones of Wisconsin and Dr. W. A. Orton (above) of the United States Department of Agriculture and by other early leaders in the development of plant pathology in America. These men were firm in their belief as to the importance of international cooperation in quarantine matters. They utilized quarantine problems in an effective manner to (1) promote international conferences, (2) establish coordinated researches between European and American laboratories and (3) encourage visits of potato specialists across the Atlantic for surveys and study. This spirit of international cooperation has endured two world wars, and the benefits to the people of Europe and America have been many. Dr. Orton traveled to Europe in 1911 where he observed the system of potato seed certification already in early operation in Germany under the leadership of Dr. Otto Appel. This

system dealt in particular with the then new potato leaf roll disease, the true nature of which was poorly understood at the time. Dr. Orton returned to America, and with Dr. William Stuart developed a plan for potato seed inspection and certification patterned after the German system. During 1912, 1913 and 1914 Dr. Orton presented this plan to members of state Potato Growers' Associations, state experiment station officials and potato specialists, and to three nationally attended scientific meetings—(1) the fifth annual meeting of the American Phytopathological Society, held at Atlanta, Georgia, December 30, 1913 to January 2, 1914; (2) the first annual meeting of the so-called National Potato Association of America, (now Potato Association of America) held at Cornell University, Ithaca, New York, February 10-11, 1914; (3) the first official Potato Seed Certification Conference held at Philadelphia, Pennsylvania on December 28, 1914. The conference at Philadelphia was called by Dr. Orton to discuss state standards for potato seed inspection and certification. All of the states and foreign countries were invited to send representatives. Thirty six delegates from Canada, Germany, Ireland, Connecticut, Kansas, Louisiana, Maryland, Michigan, Minnesota, New Jersey, New York, Ohio, Pennsylvania, United States Department of Agriculture, West Virginia and Wisconsin attended this official meeting. The Philadelphia Conference of 1914 represents a landmark in the development of efficient systems of seed potato inspection and certification in the various states and provinces. It had the advantage of a well organized full summer work shop prior to the conference, in the form of a field study trip to the principal potato growing states in the nation. Dr. Orton of the Bureau of Plant Industry of the United States Department of Agriculture organized the trip after having arranged to bring to this country as its guest, Dr. Otto Appel, the leading German authority on potato diseases. Doctors Appel, Orton, Stuart and W. J. Morse of Maine made the full summer trip visiting potato fields from Maine to California. Dr. H. T. Güssow of Canada and Dr. Johanna Westerdipk of Holland were also present for portions of the trip. In each state these authorities were met by groups of potato growers and their state experiment station plant pathologists, horticulturalists, agronomists and breeders, and visits were made to potato growing areas. The symptoms of various virus diseases of the potato were studied by these experts but the causes of these diseases were not known at that time.

Certification Objectives

The objectives of the summer field trip and the first official Potato Seed Certification conference were clearly stated by Dr. Orton as follows: "It presupposes a movement for the betterment of the potato industry, through the improvement of seed potatoes, through the development of specialized growers of seed potatoes, and through an organization created to control diseases and to reduce varietal mixture, to improve varietal types, to be stimulated by the inspection service organized by the state for the purpose of inspecting seed potatoes and granting certificates to such as may be found worthy of such certification through their varietal purity and freedom from disease."

It is significant to note that the Orton plan was designed to control potato diseases within the United States. His plan contained some basic "New England Town Meeting" concepts — it was voluntary and was to be operated on a local (state) basis. By contrast, the federal plant quarantine act of 1912 was compulsory and was operated on a national scale from Washington, D. C.

The ground work laid at the Philadelphia Conference of 1914 has been expanded over the years through the activities of the standing Seed Certification Committees of the Potato Association of America. This unusually active committee has collected and disseminated information relative to problems of the potato seed industry as they have developed and has recommended changes in the rules and regulations whenever they were considered advisable. It has been instrumental in bringing about a closer cooperation and coordination between all the agencies interested in the production and distribution of better certified seed potatoes. These aims likewise are the prime objective of this, the first issue of the Potato Handbook published by the Potato Association of America.

Pre-Certification Contributions

The problem of implementing the principles of certification formulated by the "Vermont Group" (W. A. Orton, L. R. Jones, William Stuart, W. J. Morse, C. F. Clark and P. M. Lombard) and others was undertaken by practical potato specialists. A number of these specialists studying the crop as then grown, working with potato growers and organizing potato growers' associations had already made major contributions in the improvement of American potato seed stocks. Thus we find that as early as 1885 E. S. Goff at Geneva, New York and later at Wisconsin demonstrated that tubers from productive plants gave larger yields than tubers from unproductive plants. Later, (1900-1912) similar field studies dealing with the transmission of productivity in tuber lines were reported by H. J. Eustace in New York, C. W. Waid in Ohio, H. J. Webber in New York — who first introduced the tuber-unit method during 1908—, C. L. Fitch in Colorado, A. H. Kohler in Minnesota, J. G. Milward in Wisconsin, and by others. These early workers prepared the way for potato seed certification in a practical manner by dealing with the problems of potato degeneration (virus diseases), varietal mixtures and the misnaming of varieties. Of this pre-certification group of potato specialists, J. G. Milward, starting in 1905, evolved his seed improvement program into a seed inspection and certification system as early as 1913.

Growers of certified seed located in some 28 provinces and states made steady progress both in improving the quality and increasing the volume during the early years from 1913 to 1922 as indicated in table 1. Then as now the industry received practical and scientific guidance of the highest caliber from specialists in charge of voluntary systems of inspection and certification. These men known as "Certification Officials" have successfully translated scientific principles into action programs. Their ability, integrity and accomplishments are recognized wherever potatoes are grown in America. Eight of these pioneers have been accorded the highest recognition of excellency possible in the potato industry — Honorary Life Membership in the Potato Association of America. They are:

Karl H. Fernow, New York	J. W. Scannell, Canada
H. C. Moore, Michigan	A. G. Tolaas, Minnesota
E. L. Newdick, Maine	John Tucker, Ontario
S. G. Peppin, Prince Edward Is.	H. O. Werner, Nebraska

Truly, potato seed certification represents a great cooperative effort, locally, nationally and internationally on the part of growers, dealers, potato specialists, research workers and administrators of public agencies.

TABLE I.—Summary of Potato Seed Certification in North America (1913-1922).

Location	Certification Started[1]	Acreage Certified 1922[2]	Agency[2]
	1913-1915		
Canada	"	6,642[3]	Geo. Partridge, Dominion Dept. of Agriculture
New Brunswick	"	1,325	G. C. Cunningham, Dominion Expt. Farms
Prince Edward Is.	"	2,300	S. G. Peppin, Canada Dept. of Agriculture
Idaho	"	1,464	E. R. Bennett, Commissioner Pure Seed
Maine	"	1,189	E. L. Newdick, State Dept. of Agriculture
Maryland	"	.....	No certified acreage reported
Vermont	"	588	A. H. Gilbert, State Dept. of Agriculture
Wisconsin	"	2,000	J. G. Milward, University of Wisconsin
	1916-1919		
California	"	1,384	W. V. Shear, State Dept. of Agriculture
Colorado	"	500	H. D. Locklin, State Horticulturalist
Minnesota	"	2,670	A. G. Tolaas, State Dept. of Agriculture
Nebraska	"	1,800	H. O. Werner, University of Nebraska
New Hampshire	"	.....	No certified acreage reported
New Jersey	"	288	Erdman West, New Jersey State Potato Ass'n.
New York	"	1,375	M. F. Barrus, New York State College of Agr.
North Dakota	"	8,249[4]	H. L. Bolley, State Seed Commissioner
Ohio	"	.....	No certified acreage reported
Oregon	"	550	E. R. Jackman, Oregon Agricultural College
	1920-1922		
Kentucky	.....	.....	No certified acreage reported
Michigan	"	2,429	H. C. Moore, Michigan Potato Producers' Ass'n.
Montana	"	318	F. M. Harrington, Univ. of Montana
Pennsylvania	"	316	R. E. Hartman, Dept. of Agriculture
South Dakota	"	.....	No certified acreage reported
Utah	"	17	H. J. Webb, Staate Board of Agriculture
Washington	"	216	J. E. Currey, State Dept. of Agriculture
Wyoming	"	.....	No certified acreage reported
Alberta and Saskatchewan	——	300	J. W. Scannell, Univ. of Saskatchewan
British Columbia	——	105	C. Tice, Canada Dept. of Agriculture

[1]Records taken from listings supplied by Karl H. Fernow and H. C. Moore.
[2]Compiled by A. G. Tolaas.
[3]Total for Canada.
[4]Inspected for certification.

POTATO PULP IS A NEW DAIRY FEED

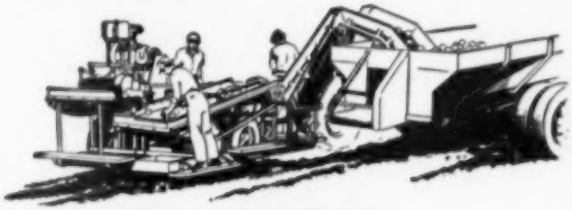
This year, for the first time, dried potato pulp, a new feed for dairy cattle, will appear on the market. Dr. Matthew E. Highlands of the Maine Agricultural Experiment Station carried out much of the original research in developing dried potato pulp. At the present time the Station is repeating some of the feeding work to determine the value of dried potato pulp for dairy cows. This new feed is a product resulting from the pressing and dehydrating of the wet by-product from the potato starch factories.

The chemical analysis of this product is Water 12.51 per cent, Protein 3.50 per cent, Fat .47 per cent, Fiber 11.23 per cent, Nitrogen-Free Extract 64.64 per cent, and Minerals 7.65 per cent.

From this analysis, it appears that dried potato pulp is low in protein and fat, and high in fiber content and other carbohydrates. If the pulp is fed to milking cows at the 20 per cent level in a grain mixture containing 18 or 19 per cent protein and which contains grains that are low in fiber and high in fat, it gives very satisfactory results.

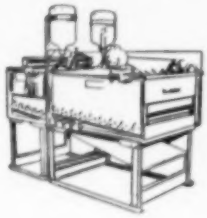
MORE PROFITS with LESS LABOR

WITH MECHANIZED JOHN BEAN EQUIPMENT



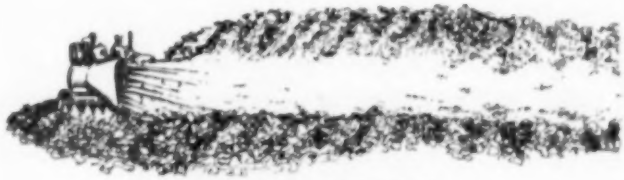
POTATO HARVESTERS

A crew of 3 to 7 and a John Bean Potato Harvester does the work of 15 hand pickers. Solves the problem of getting manpower. Cuts labor costs as much as one-half. Two models available, Model 26—for harvesting 1-row direct or 2-rows indirect, Model 60—2-rows direct or 2-or more rows indirect.



PACKING EQUIPMENT

John Bean offers a complete line of packing house equipment. Graders, Conveyors, Cleaners, Washer-Absorbers, Waxers, Potato Laundry, etc. (Washer-Absorber and Waxer units shown at left.) For the answer to any packing problem, choose from the complete John Bean line.



ROW CROP AIR SPRAYERS

Now all the growers of row crops can enjoy the many benefits of modern air spraying. The performance proven John Bean Aircrop attachment—available in both 15-RC and 8-RC models—converts high pressure sprayers into modern air-type units quickly and economically. An Aircrop is a versatile time and labor saver — the tractor driver is the one-man crew. Spray dilute, semi-concentrates, or concentrates. Eliminate the number of water hauling trips. Get maximum performance with an Aircrop.

JOHN BEAN DIVISION fmc FOOD MACHINERY AND CHEMICAL CORPORATION LANSING 4, MICH

QUALITY STARTS HERE —

Index Plot, Masardis, Maine

Maine seed growers have unique opportunities to produce quality seed because of the work being done at the Masardis Farm operated by the Maine Seed Potato Board. Here, indexed lots are carefully increased and distributed to growers. This work plus the many other phases of seed improvement work done in Maine makes your best buy —

MAINE CERTIFIED SEED POTATOES

All Popular Eastern Varieties
Available in Following Grades

Blue Tag — US No. 1 — 1⅞" to 3¼"

Green Tag — US No. 1 — 1½" to 2"

White Tag — US No. 1 — 1½" to 2¼"

Call Your Dealer for Quotations

For List of Growers Write:

E. L. Newdick, Chief, Division of Plant Industry
Augusta, Maine

NEW VARIETIES – THE MAINE WAY

In Maine, the development, naming, and increase, of new varieties is systematically achieved through the cooperation of both Federal and State agencies. Most of the new seedlings originate with the U.S.D.A. potato breeding program which operates a large sub-station at Presque Isle. As promising new seedlings are produced they are carefully tested for yield, quality, appearance, disease resistance and many other factors by both the U.S.D.A. and the Maine Agricultural Experiment Station. When a new seedling is selected that shows particular promise, a few tubers are taken to the State Seed Board Farm at Masardis for increase. If this seedling shows sufficient good qualities to warrant consideration for naming, this decision is made by a committee chosen for this purpose. Only varieties having outstanding qualities are given a name. After naming, the Seed Board increases the original lot until it is of sufficient size to distribute to a few foundation growers. From the foundation growers the seed moves to certified growers and then out into the trade. By the use of this procedure, a new variety gets off to a good start with only high quality seed being distributed. Some of the old headaches associated with a new variety should be eliminated.

Listed below are some of the varieties now being increased for distribution:

Pungo— (B76-43) Named in 1950 jointly by the Virginia Truck Experiment Station and U.S.D.A. Resistant to late blight (Common Races); high yields; matures slightly later than Cobbler; cooking quality comparable to Green Mountain in Maine; tubers tend to be rough but not as bad as Cobblers; very promising variety for Eastern Shore. Limited quantity of certified seed available in Maine.

Saco— (B606-67) Named in 1954 jointly by the Maine Agricultural Experiment Station and the U.S.D.A.; resistant to late blight (Common Races); very high yields; immune to virus x; very high dry matter; potentially a good variety for processing. No seed available until 1956 or 1957 in Maine.

Delus— (B73-18) Named in 1954 jointly by Delaware and the U.S.D.A.; resistant to late blight (Common Races); high yields; high dry matter; very attractive in Delaware. No seed available in Maine at present.

Merrimac— (B355-44) Named in 1954 jointly by New Hampshire and the U.S.D.A.; resistant to late blight (Common Races) and ring rot; high quality; promising in New Hampshire. No seed available in Maine at present.

Old Varieties Too

A very similar system is used in Maine to distribute improved strains of the older varieties. Selected, indexed lots are built up from a few tubers on the Masardis farm to lots large enough to distribute to foundation growers. This system has been in operation with the Katahdin variety for nearly ten years and has resulted in a great improvement in this variety. Lots having a low percentage of Virus X infection yield higher and produce a much more uniform crop than those having a high degree of infection. It has been found that lots practically free from Virus X can be maintained at a low level of infection for several years if properly cared for.

CERTIFIED SEED POTATOES

FROM

New Brunswick

CANADA

NEW BRUNSWICK CERTIFIED SEED POTATO GROWERS OFFER YOU—

- 20,000 acres of certified seed of all the popular potato varieties.
- 37 years' experience in growing certified seed
- Seed potatoes grown from seed that has been tested and tuber indexed in the greenhouse.
- Seed that has been pre-tested in the Florida Seed Potato Plots.

DEPARTMENT OF AGRICULTURE

FREDERICTON — NEW BRUNSWICK — Canada

Hon. C. B. Sherwood, Minister

E. M. Taylor, Deputy Minister

CERTIFIED SEED POTATOES IN THE PROVINCE OF NEW BRUNSWICK

New Brunswick is one of the chief potato producing provinces of Canada and its importance lies in the fact that it is one of the few potato exporting provinces. New Brunswick certified seed potatoes are well known.

Potato certification in the Province began during the First World War. At that time New Brunswick produced 2,000 acres of certified seed and the principal potato varieties were Green Mountain, Irish Cobbler and Spaulding Rose. The variety Bliss Triumph was introduced for certified seed in 1924, and the tuber unit method of planting was introduced to improve the seed of this variety.

The potato breeding program for Canada is located in New Brunswick and was started in 1933. Recently two potato varieties have been released, namely the Keswick and Canso.

In 1936 small lots of potato varieties were shipped to South America and as a result, commercial potato shipments were made in 1938. Export shipments of certified seed are made yearly to South America, the Caribbean countries, and the United States, and shipments are also made to domestic markets in Canada.

In 1939 certified foundation seed stock areas and certified seed stock areas were established for the production of certified seed, and in 1949 the Upper Saint John River Valley Disease Control Area was established, which consisted of a large area including the foundation and certified seed stock areas. The purpose of establishing these areas was disease control and the betterment of New Brunswick certified seed.

In 1943 tuber indexing work was started with the seed potato varieties Green Mountain and Irish Cobbler to further improve New Brunswick seed.

The potato growers in New Brunswick have grown up with the potato industry, benefited from experience, and developed the art of growing and caring for potatoes with great skill. The potato grower carries out the various operations as planting, cultivating, spraying or dusting, and harvesting, with a thorough knowledge of all operations, which results in a superior product. The growers have adopted many changes through the years to improve potato growing, which has resulted in an improved commodity that has gained favor on world markets.

The New Brunswick certified seed potato producers have adopted still another practice to improve the quality of their seed, namely "Advanced Testing" of their seed potatoes in a warm climate during the winter months, and it is referred to as the Florida Seed Potato Test because this work is carried out in Southern Florida. The purpose of the Florida seed potato test is to obtain and supply to growers and buyers advanced information on the disease content in any lot of seed and thereby enables the grower to avoid planting seed, or the purchaser from buying seed which will contain more disease than inspection standards for certification will allow.

The potato industry of New Brunswick has also kept pace in the production of potato by-products and such commodities as potato chips, potato starch, etc., are on the market in liberal quantities.

The Province of New Brunswick has the quantity and quality of both certified seed and table potatoes to meet the requirements of northern, central and southern countries.

NEW YORK CERTIFIED SEED POTATOES

TWO OR MORE INSPECTIONS OF VINES

TUBERS PROPERLY GRADED AND INSPECTED

Some of our growers have been in the business over 30 years. Many are sons of certified seed growers. Every lot is tested in Florida for virus disease. Results available in February.

VARIETIES CERTIFIED IN 1955

Canoga	Irish Cobbler	Red Pontiac
Cherokee	Katahdin	Russet Burbank
Chippewa	Kennebec	Russet Rural
Essex	Ontario	Sebago
Green Mountain	Pontiac	Smooth Rural

When Better Varieties are Available We Will Grow Them

For complete list of growers write to

NEW YORK CERTIFIED SEED GROWERS' COOPERATIVE, INC.,

N. Y. STATE COLLEGE OF AGRICULTURE, ITHACA, N. Y.

SEED POTATO INVESTIGATIONS IN NEW YORK

K. H. Fernow

The breeding program at the New York Station has resulted in the introduction of seventeen new varieties since 1940. At the present time, as far as known, only four of these are still in commercial production. These are Harford, which has found a place in Central America; Ontario, grown on scabby soils in New York; Essex, outstanding for high yield; and, Canoga, noted for high quality. Some of the varieties were discarded because of disappointment that the varieties were less resistant to late blight than had been hoped. However, the degree of blight resistance was the same as that of the popular Kennebec variety and others introduced more recently. We would like to try again our first introduction, Empire, but unfortunately have no seed. We would like to hear from anyone who can supply us with one or more tubers of Empire.

The breeding program is being vigorously prosecuted with special emphasis on resistance to blight, scab, black spot and golden nematode. Attention is also being given to such factors as specific gravity, appearance and yielding ability.

Another project of the station is to assist seed potato growers to produce seed free from the X-virus. Individual tubers are indexed and tested in the greenhouse and then returned to the growers for multiplication. In the course of this work we have discovered some stocks of certain varieties almost completely free from X-virus. There are now 51 acres of Chippewa, 103 acres of Katahdin, 7 acres of Cherokee and 10 acres of Red Pontiac under inspection and free from X-virus.

TREXLER

POWER
SEED POTATO
CUTTERS
and
ALUMINUM
POTATO SCOOPS

ALBERT E. TREXLER

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"QUALITY SEED POTATOES"

- Field Inspected
- Winter Tested
- College Supervised
- All Standard Varieties

CERTIFIED TO THE TIGHTEST SEED POTATO TOLERANCE IN THE EAST

New York Co-operative Seed Potato Association, Inc.

Georgetown, N. Y.

THE RESPONSIBLE MARKETING AGENCY OF THE BEST SEED POTATO GROWERS IN NEW YORK

Science Service

CANADA DEPARTMENT OF AGRICULTURE

Seed Potato Certification

Plant Protection Division

ACRES PASSED BY VARIETIES (PRELIMINARY) — 1955

Varieties	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	TOTAL
Sebago	16,793	30	475	34	151	...	...	...	3	17,486.0
Katahdin	1,346	53	6,660	272	823	6	...	...	21	9,181.0
Irish Cobbler	3,074	73	433	143	146	27.5	...	33	5	3,934.5
Netted Gem	55	42	559	...	1	81.5	31	800	1,507	3,076.5
Green Mountain	1,011	29	236	1,557	62	9.5	...	1	46	2,951.5
Kennebec	398	64	1,026	351	5	45.5	1	...	23	1,913.5
Pontiac	88	2	495	...	0.3	12	8	27	30	662.3
Keswick	184	22	111	67	152	6	...	...	2	544.0
Canso	305	12	92	42	55	1	...	...	...	507.0
Russet Rural	31	...	373	1	14	...	...	...	...	419.0
Warba	104	27	3	10	16	36.5	9	76	83	364.5
Bliss Triumph	8	46	274	...	...	8.5	6	6	0.5	349.0
Red Pontiac	...	...	205	...	.....	78	...	...	...	283.0
Chippewa	13	8	17	...	216	...	...	...	...	254.0
White Rose	...	...	...	...	.....	...	...	...	129	129.0
Cherokee	15	19	8	...	4	...	...	...	...	46.0
Ontario	3	...	12	...	106	...	...	...	...	121.0
Columbia Russet	...	...	...	...	2	68	28	1	4	103.0
Early Epicure	9	...	...	...	.....	...	...	2	49	60.0
Manota	...	...	...	...	2	37.5	5	0.2	...	44.7
Early Ohio	...	...	...	...	.....	38.5	7	2	...	47.5
Red Warba	...	...	...	...	.....	34.5	...	...	0.2	34.7
Teton	...	2	1	24	.....	...	...	...	...	27.0
Waseca	...	...	...	...	.....	17	...	...	...	17.0
Early Rose	...	1	...	...	0.2	...	...	...	15	16.2
Canus	...	...	...	...	1	4.5	1	5	4	15.5
Gold Coin	...	...	...	...	.....	...	...	...	16	16.0
McIntyre	9	...	...	...	.....	...	...	...	...	9.0
Carter's Early Favorite	...	...	...	...	.....	...	...	6	...	6.0
Sequoia	8	...	...	...	.....	...	...	...	...	8.0
Arran Victory	...	2	...	...	.....	...	...	...	...	2.0
Pawnee	...	4	...	...	.....	...	...	...	...	4.0
Mohawk	...	2	...	...	.....	...	...	...	...	2.0
Rural New Yorker	...	...	...	...	.....	...	...	...	...	4.0
Garnet Chili	...	1	...	...	4	...	...	...	...	1.0
Clark's #3	...	0.3	...	...	.....	...	...	...	...	.3
White Bliss	...	...	0.3	...	.....	...	...	...	...	.3
Wee McGregor	...	...	...	...	.....	...	...	...	0.3	.3
Total	23,454	439.3	10,980.3	2,501	1,760.5	512.0	96	959.2	1,938.0	42,540.3
1954 Totals	24,062.75	457	19,283.5	2,173.7	1,579.15	404.0	85.6	906.5	1,734.75	50,687.0

POTATO SEED CERTIFICATION IN CANADA, 1915-1955

J. W. SCANNELL
Plant Protection Division
Canada Department of Agriculture

Seed potato certification was started in the Maritime Provinces of Canada in 1915. There were at least two factors that brought about this system of potato improvement.

1. Shipments of potatoes from Canada to the United States were found to be infected with powdery scab. An embargo was placed on Canadian potatoes by the United States Government, but shipments were allowed to move forward when certified as free of this disease by Canadian inspectors. This led to a system of field inspection for powdery scab and other diseases.
2. Bermuda bought potatoes for seeding purposes from the Province of Nova Scotia for many years, but by 1915 they reported that this seed was not producing as good crops as formerly, due to the presence of virus diseases. To satisfy this market and to interest other purchasers, a system of inspection and certification was set up.

It is interesting to note that the first person who was put in charge of this new certification system by the Dominion Botanist, Dr. H. T. Güssow, was Paul Murphy who was brought over from Ireland. Mr. Murphy was placed in charge of the work in Prince Edward Island and Nova Scotia and Mr. Gilbert C. Cunningham was given charge in New Brunswick and Quebec. Mr. Cunningham made a valuable contribution to the early work of the service in New Brunswick, training inspectors. In 1918, in order to effect more uniformity, Mr. Murphy was designated as chief inspector for the whole service in the Maritime provinces and Quebec.

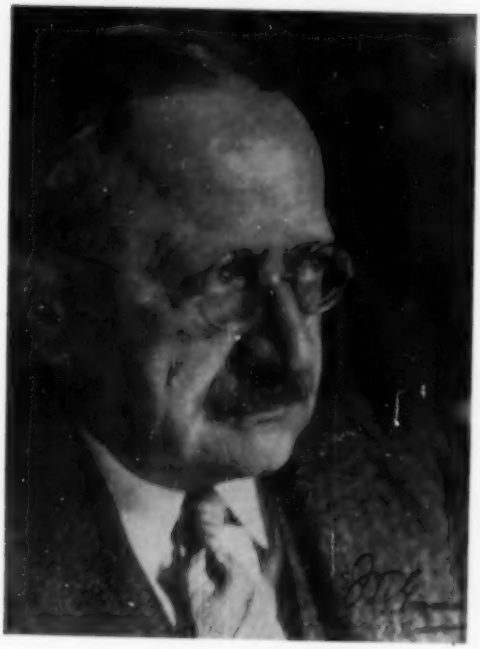
The certification system was gradually extended to nine provinces of Canada by 1927. An Act was passed which gave the Federal Government complete jurisdiction over all potato certification in Canada. This has been a great boon to the development of all the work as all Canadian seed is produced under the same set of standards.

The work progressed rather slowly between 1915 and 1919 but by 1920 over 3,000 acres were certified. As our knowledge of viruses and other diseases increased, our tolerances have been lowered until they are comparable to any standards in the world. Actually, the standards are under constant review.

Since 1939 two classes of seed have been produced — one Foundation and the other Certified. The amount of disease allowed in Foundation is extremely low and this stock is intended for the production of certified seed while the Certified class is for the production of high class table stock.

At the beginning, Garnet Chili, Irish Cobbler and Green Mountain varieties were the most popular. However, by 1953 Katahdin and Sebago represented over 75% of the total acreage. In addition, new varieties are appearing on our lists each year.

It might be explained that in Canada a potato variety must be licensed for sale before it is eligible for certification. In order to have a variety licensed, it must be tested in the National Trials and found to be superior in some of the more important aspects, such as disease resistance, before a committee



HANS THEODOR GUSSOW
1879-

The man who started potato seed certification in Canada. His keen perception and tireless devotion to his task were largely responsible for the excellent foundation on which potato seed certification was started. He spent almost 40 years with the Canada Department of Agriculture. Dr. Gussow was Dominion Botanist from 1909 to 1945.

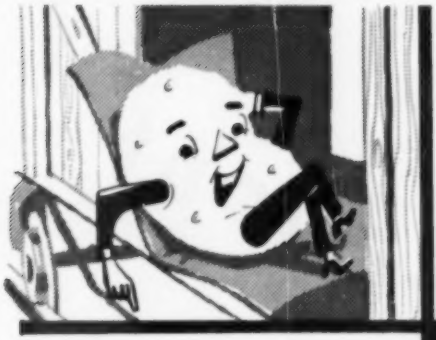
set up for the purpose will recommend it for licensing. This system prevents unsuitable varieties from being offered to the public.

Tuber unit planting was started in Nova Scotia in 1921 and in 1924 tuber indexing was started in the same province. These two systems of improvement are now common practice in most provinces.

In 1949 Newfoundland became a province of Canada but due to the presence of potato wart in this new province, potato seed certification is not being carried on there. Regulations prevent the movement of potatoes from this province to other provinces and to any other part of the world.

The history of potato seed certification in Canada during the last 40 years has been one of steady improvement. From a modest beginning in 1915, production has averaged approximately 15 million bushels during the past 10 years. Shipments are made to many parts of the world with the United States taking a large percentage of the total exports.

One of the papers on the Early History of Seed Certification in North America.



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Extensive information regarding this topic is contained in a recent bulletin, "Fewer Applications of DDT With Proper Timing Produce Equal Yields of Potatoes At Less Cost." The bulletin was published by the Maine Agricultural Experiment Station in cooperation with the United States Department of Agriculture.

The authors, G. W. Simpson, head of the Department of Entomology, and W. A. Shands, entomologist of the USDA, Entomology Research Branch, found no positive evidence that potato-infesting aphids have developed an increased tolerance or resistance to several common insecticides.

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- Houma
- Cherokee
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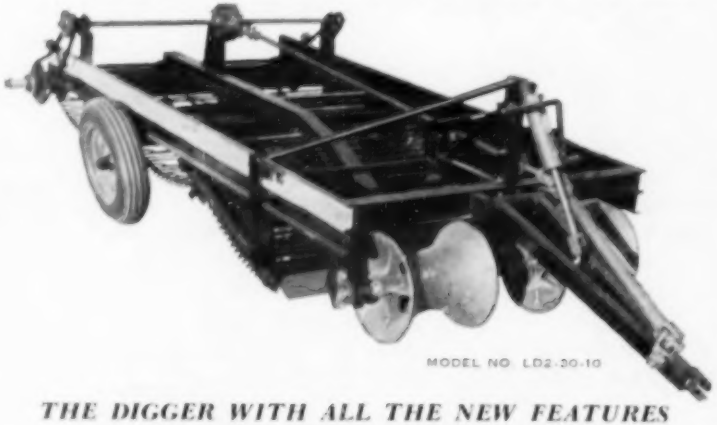

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POTATO BREEDING IN THE UNITED STATES

F. J. Stevenson, *Principal Geneticist, Horticultural Crops Research Branch, Agricultural Research Service, United States Department of Agriculture*

1621 to 1850

The potato was introduced into Virginia from the Bermuda Islands in 1621, but it is thought potato growing got its best start in 1719 when potatoes were brought from Ireland by a colony of Scotch-Irish immigrants who settled at Londonderry, N. H. For the succeeding 100 years it is probable that the varieties grown were of English origin. However, early in the 19th century scientists were beginning to take an interest in producing improved varieties, but from 1811 to 1850 only 4 varieties were released (1).

Dr. Frederick J. Stevenson, Principal Geneticist, bagging potato seed balls at the Plant Industry Station, U.S.D.A., Beltsville, Md.

1850 to 1900

The severe epidemic of late blight that swept over this country and Europe during the years 1843 to 1847, resulting in the Irish Famine, gave impetus to a search for potato varieties that would resist the dreaded disease. It was thought that the potato had become so weakened as a result of long continued asexual propagation from seed-pieces that it would no longer resist the attacks of the disease and that the vigor could be restored by growing the crop from true seed produced in the fruits of the potato plant.

From 1850 to 1900 there was great activity among amateur potato breeders in an effort to produce more vigorous and productive varieties that would be able to resist disease. The breeders of that day were mostly growers. Two notable exceptions were the Reverend C. E. Goodrich, a clergyman of Utica, N. Y., and E. S. Carman, former editor of the *Rural New Yorker* (4). In 1851 Goodrich secured, through the American Consul at Panama, a small quantity of South American potatoes. In the lot was a variety Goodrich named the Rough Purple Chili. From the naturally fertilized seed balls of this variety in 1852 he grew a relatively large number of seedlings in 1853. From these seedlings he selected and released the varieties Calico, Cuzco, Early Goodrich, Garnet Chili, Amazon, Central City, Coppermine, and several others.

The importance of the work of Goodrich lies not so much in the varieties he himself originated as in the many varieties that were subsequently produced related to his breeding stock. According to Stuart (3) 170 varieties, subsequently produced, were related more or less to Garnet Chili. Many of these, such as Acme, Acorn, Admiral, Foote, Advancer, Albino, and Aroostook Beauty, to name only a few, have long since been forgotten, but others such as Beauty of Hebron, Blue Victor, Burbank, Early Ohio, Early Rose, Green Mountain, Peachblow, Peerless, Russet Burbank, and Triumph are familiar to most of us.

Carman did not succeed in getting seed balls on his own varieties of potato, so advertised for potato seed in the *Rural New Yorker*. Some seed was received from Europe, and from this beginning he produced Carman 1, 2, and 3. When Carman No. 2 was released it was called Rural New Yorker No. 2. Sir Walter Raleigh was produced from seed of Rural New Yorker No. 2, and Russet Rural originated as a sport of the latter variety.

From 1850 to 1910 about 380 varieties were introduced to the commercial trade (1). Of 328 varieties whose origin is known 306, or 93.3 per cent, originated as seedlings and 22, or 6.7 per cent, as sports. Data concerning the place of origin have been reported for 288 varieties. Twenty-one States, extending from the Atlantic to the Pacific, shared in the production of these varieties. The list of the States and the number of varieties produced by each are given in table 1.

The best known private breeders other than Goodrich and Carman who had a part in breeding the many varieties that were released during the last half of the 19th century were Breesee, Brownell, Pringle, Rand, Gleason, Heffron, Burbank, Alexander, Reese, Coy, Craine, Bovee, Safford and Van Ornam (4). None of the varieties released were resistant to late blight but with the introduction of fungicidal controls they could be grown successfully, and the interest in breeding blight-resistant sorts lagged for a time.

1900 to 1910

Soon after 1900 the State Agricultural experiment stations and the United States Department of Agriculture assumed the leading role in potato breeding and had the same objectives as were sought in the last half of the 19th century. However, the methods were improved. With few exceptions, the private breeders grew seedlings from seed balls resulting from chance pollination. The scientists made crosses between carefully chosen parents and selected the resulting seedlings systematically.

TABLE 1.—*The States where 288 varieties of potato originated and the number of varieties that were produced in each, 1850-1910.*

State	Number varieties produced
Colorado	1
Connecticut	5
Illinois	2
Indiana	4
Iowa	6
Maine	38
Massachusetts	10
Michigan	12
Minnesota	5
New Hampshire	4
New Jersey	5
New York	74
North Dakota	1
Ohio	15
Oregon	4
Pennsylvania	7
South Dakota	1
Vermont	71
Virginia	1
Washington	1
Wisconsin	21

Several European countries had made definite progress in breeding disease-resistant varieties of potato, so in 1904 L. R. Jones (2), botanist of the Vermont Agricultural Experiment Station and collaborator of the Bureau of Plant Industry, acting in behalf of the United States Department of Agriculture, visited Europe. He spent 6 months studying potato diseases, the methods used for their control, and especially the breeding of disease-resistant varieties. Dr. Jones assembled a collection of about 100 varieties that were claimed to have resistance in the field to late blight. This collection, which was brought to the United States included British, German, Dutch, and French sorts. The European varieties were tested for adaptation and other characters by the Bureau of Plant Industry, of the United States Department of Agriculture at Arlington Experimental Farm, in Virginia, and at the State agricultural experiment stations of Vermont, Florida, Colorado, and Oregon. L. R. Jones and William Stuart, the latter then horticulturist at the Vermont Station, jointly tested the varieties sent to Vermont for their reaction to late blight and their combining ability in crosses with American varieties.

1910 to 1919

In 1910 Stuart was appointed horticulturist in charge of potato investigations for the United States Department of Agriculture. During the next decade he made hundreds of crosses and grew thousands of seedlings with resistance to late blight his major objective. Numerous blight-resistant seedlings were

produced during this period but none of them possessed the necessary characteristics of a good market potato and none of them was released to growers.

1919 to 1929

From 1919 to 1929 C. F. Clark was in charge of the potato-breeding work of the United States Department of Agriculture in Maine. The widespread occurrence of potato viruses convinced him that it was more important to breed varieties that were resistant to virus diseases than varieties resistant to late blight. In 1919 there were no formal tests for resistance to viruses but natural epidemics occurred every year. At the time, mild mosaic was the commonest virus disease in Maine and the one that took the heaviest toll of the seedlings. Seedling varieties that escaped infection were slected. These were crossed with one another and with other seedlings and varieties. The most promising seedlings were selected. The success of this program is seen in the varieties immune or near immune to mild mosaic that have been released to growers such as Katahdin, Chippewa, Houma, and Earlaine. Another accomplishment of this period was the production of lines immune from virus X. The first seedling variety to show this character was 41956. This seedling was first grown in 1921, but its immunity from virus X was not known until about 10 years later. Since then numerous seedling varieties have been bred immune from X, and one variety, Saco, has been released.

1929 to 1955

In 1929 the National Potato-Breeding Program was organized, the work of which was to be done by State agricultural experiment stations in cooperation with the United States Department of Agriculture. Agreements of understanding were drawn up between the Department and 9 States. Now (1955) there are 28 such agreements and informal cooperation with 11 other States and 3 territories, all at present cooperating in a more or less extensive way. Cooperation is carried on also with Canada and a number of other foreign countries. The author has been in charge of this program since 1930.

Dr. Stevenson and assistants harvesting potato seedlings at Plant Industry Station, Beltsville, Md.

In 1930 the Federal breeders and pathologists joined forces and with the help of a number of State scientists the program grew very rapidly. The work of breeding for disease resistance was expanded to include not only resistance to mild and latent mosaic but to many other diseases, such as veinbanding mosaic, rugose mosaic, leaf roll, net necrosis, spindle tuber, late blight, dry rot, common scab, verticillium wilt, wart, ring rot, brown rot, and hopperburn. A relatively high degree of resistance to each of these diseases has been combined with horticultural characters, and a number of varieties have been released. Some of these varieties are high yielding, have good market and cooking qualities, and are highly resistant to two or more major diseases.

Some of the varieties that were released under the National Potato-Breeding Program, listed under the disease to which they are highly resistant follow:

Mild Mosaic. Cherokee, Chippewa, Earlaine, Houma, Katahdin, Kennebec, Merrimack, Saco, Sebago, Teton and Sequoia.

Latent Mosaic. (virus X) Saco.

Yellow Dwarf. Sebago.

Net Necrosis. Cherokee, Chippewa, Earlaine, Houma, Katahdin, Kennebec, Merrimack, Saco, and Sebago.

Late Blight. Boone, Cherokee, Delus, Kennebec, Merrimack, Plymouth, and Pungo.

Dry Rot. Cherokee, Delus, Kennebec, Merrimack, Saco, and Sebago.

Early Blight. Merrimack.

Common Scab. Cherokee, Cayuga, Menominee, Ontario, Pungo, Plymouth, and Seneca.

Verticillium Wilt. Houma, Menominee, Ontario, and Saranac.

Wart. Katahdin, Mohawk, Sequoia, Mesaba, and Norkota.

Corky Ringspot. Merrimack and Plymouth.

Ring Rot. Merrimack, Saranac, and Teton.

Hopperburn. Sequoia.

Varieties resistant to two or more major diseases are: Cherokee, Houma, Katahdin, Chippewa, Kennebec, Menominee, Merrimack, Ontario, Saco, Sebago, Saranac, Plymouth, Sequoia, and Pungo. Saco, released in 1954, is resistant to five diseases: latent mosaic, mild mosaic, rugose mosaic, net necrosis, and late blight.

Summary

The potato was introduced into Virginia in 1621, but potato growing in the United States probably got its best start in 1791 by the Scotch-Irish immigrants who settled at Londonderry, N. H. From 1850 to 1900 many growers and amateur breeders were at work in an effort to produce varieties resistant to late blight. From 1850 to 1910 380 varieties were introduced to the commercial trade but none was resistant. Varieties were produced in 21 States. In 1904, about 100 European varieties with various reactions to late blight were brought to the United States. In 1910 breeding for late blight resistance was undertaken by the United States Department of Agriculture. In 1919 the program was changed to breeding for resistance to mild mosaic. In 1930 the program was enlarged to breed for resistance to other diseases.

Varieties of potato have been released highly resistant to each of the following diseases: Mild mosaic, latent mosaic, yellow dwarf, net necrosis, late blight, dry rot, early blight, common scab, verticillium wilt, wart, corky ring-

spot, ring rot, and hopperburn. Fourteen varieties are resistant to 2 or more major diseases. Saco is resistant to 5 diseases: latent mosaic, mild mosaic, rugose mosaic, net necrosis, and late blight.

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A POTATO MARKETING PLAN

TED STILL, *President*
San Luis Valley Potato Improvement Association
Monte Vista, Colorado

Since the time when the United States first became a federated union, the government has enacted laws and made directives protecting various segments of the country against unfair abuses. We potato growers feel that such protection is fair and we assume it is also constitutional under our democratic form of government, to serve the people in that way. But we also feel that if one segment of the economy is protected, all segments should be protected. We would like to call attention to a few segments of the economy that are protected directly and indirectly.

1. Railroads — by land grants and protective commissions.
2. Public utilities — by granting monopolies under commissions.
3. Building trades — by loans to veterans and direct grants for slum clearance.
4. Farming — by protective tariffs, research and educational programs, and the subsidization of some farm produce.
5. Labor — by minimum wage laws, closed shops, union shops, and laws granting the right to bargain collectively.
6. Heavy industry — by protective tariffs, harbor and river legislation and control, building and maintaining transportation systems and the particular benefits following the two world wars of low interest rates and the generous reconversion programs.

There are many others. Nearly every segment of the country, nearly every individual, through schools or other institutions, through the post office department, by our public roads, police protection, disaster relief or in some other way, benefits in some manner by a helping hand from the Government.

Now, the potato growers can see no reason why they should not ask the government for aid — not as subsidies, we don't want subsidies — but for bargaining power, and a protective law while we exercise that power. We have done everything the Government has asked of us as nearly as we could. Without the proper organization and laws it was impossible to control the acreage in strict accordance with USDA guides. Sometimes those guides were not correct either. In that regard there should never be any guide or influence to cause a shortage of potatoes — the public is entitled to a plentiful supply — but the way the market is today, we are helpless unless potatos are in short supply. We have been led to believe that potato farmers could not expect good prices when there are surpluses, that we were to blame for planting too many. Yet we have repeatedly been the victims of unfair trade practices when potatoes were not in surplus supply. An example of this was the 1954 crop marketed during the 1954-1955 marketing season. Never were there too many potatoes during that season; the demand should have been good and the price equal to parity all year; yet the potato farmers of the country lost money. We can't take much more of that sort of thing and survive.

Therefore, it is suggested that the potato farmers of the United States organize and ask Congress for a specific act which will grant to them the right and authority under a commission in the USDA, to restrict the supply going to market any time the price drops below 100% of parity. This sort of a plan will involve in the beginning considerable effort by a great many

potato growers. It will also involve spending money for organizing and legislation. It will also have to be effected over some opposition. The point to remember is: In years when potato farmers have sold no more than 330,000,000 bushels in one year, they have realized about $500,000,000 for the crop. In years when they sold 350,000,000 bushels or more, the potato farmers have realized about $300,000,000 for the crop. Think those figures over a moment. No area has been exempt from this economic reaction. Therefore, how could any grower or potato producing area suffer from efforts to bring about the favorable figures of a shorter supply.

Space will not permit going into detail here. But a brief description of what would be desirable follows:

1. Allocate marketing quotas — the number of bushels that could be sold through food channels — to the states, by a national committee of potato growers in cooperation with the USDA. Each state would break down its quota into individual quotas. These quotas would be allocated in accordance with national consumption figures that favor an active market and a good price, and would be based on past production history. Make no other attempts than the use of past production history, to regulate acreage.

2. Empower the national committee to declare shipping holidays to regulate marketing gluts and maintain a fair market price.

3. Empower the Federal-State inspectors to issue sales permits in agreement with quotas and in accordance with grade regulations established by the individual states or areas.

4. Establish a commission under the USDA to regulate against any attempt at monopoly price fixing by the potato growers. This commission would have the power to issue additional quotas at any time the price rose appreciably above 100% of parity. (We do not believe the potato growers should have the right to effect unregulated price fixing any more than anyone else and the anti-trust laws were created for, and have endeavored to, protect the public from this sort of thing for a great many years.)

5. Finance this program by levying a fee per bushel or cwt. on all potatoes sold in food channels. One cent per bushel would provide a national fund of more than three million dollars annually. The yearly cost to administer this plan should not exceed two cents per bushel.

6. Each grower would dispose of his own surplus into some non-food channel at no cost to the Government.

In addition to the above, the potato growers should inaugurate a national advertising and improvement program to increase the consumption of potatoes. If we are to insist that the potato grower receive 100% of parity, then we must likewise insist that the consumer get the best quality possible for the money. This can be done by improving production and handling methods to reduce culls and off-grades. We should sponsor research to this end.

The thought behind this plan is to help the potato grower; not to run some area out of the potato business. Most of the remaining potato areas are quite stable. They will probably all stand together or fall together. Anyone who believes differently, that they can drive the others out of business, should look back over their shoulder and have another guess. Each area has its disadvantages. Some have high fertilizer bills, some have high water costs, others have comparatively low yields while others have excessive freight rates.

If we all work together, there is no reason why we cannot enjoy a reasonable degree of prosperity even though the bushels produced aren't always exact or the acreage entirely within bounds.

POTATO SEED CERTIFICATION IN MAINE, 1914-1925

DONALD FOLSOM
University of Maine

A letter dated November 12, 1913, from W. A. Orton of the U.S.D.A. to W. J. Morse states: "I have worked out a few of the details of a plan for official inspection and certification of seed potatoes which I thought of recommending for adoption in the principal potato-growing states. I shall be very glad to have you read this critically with particular reference to its applicability to conditions in Maine and then give me your advice regarding it." The plan included several paragraphs prepared by William Stuart. In passing, it may be noted that Orton, Morse, and Stuart were all Vermonters.

The most interesting ideas in the Orton-Stuart plan are briefly as follows: limitation to States exporting seed; fining and permanently disqualifying any grower for the use of official certificates on uninspected stock; a preliminary reading of a 100-tuber sample in the South, arranged by the U.S.D.A.; disapproval of tubers having pointed or wedge-shaped ends; scab tolerance of 10 per cent; roguing Rhizoctonia stem-blight; zero tolerance of powdery scab, Verticillium wilt and leafroll.

The certification rules used in Maine in 1914 included the following interesting requirements: seed treatment with formalin to prevent blackleg and common scab; zero tolerance of powdery scab and leafroll; 5 per cent tolerance of poor-yielding hills in 100-hill-per-acre samples; at third inspection, between harvest and shipment, agreement of grower to grade out all tubers with decay, severe mechanical damage, severe scab, and severe black scurf.

The seed-treatment requirement and the zero leafroll tolerance persisted through 1920. The 100-hills-per-acre sampling rquirement persisted through 1922. The 1920 rules do not mention roguing; from 1921 through 1925, weak hills and those with mosaic, curly-dwarf, leafroll, blackleg, and wilt were to be rogued during inspection.

In the early twenties the results of research on virus diseases brought in some new rules. One new rule disqualified a field where nearer than 250 feet to other fields with more than the passing allowance for mosaic and leafroll. Another established a tolerance of 5 per cent spindle tuber at the second inspection. In the same period, probably as the result of experience, the tolerance for blackleg and wilt was raised and the tolerance for mosaic was reduced. Meanwhile the acreage certified increased from 462 in 1920 to 14,700 in 1924.

During practically all of the period 1914-25, certification in Maine was under the direction of E. L. Newdick of the State Department of Agriculture, while virus-disease research in Maine was carried on by E. S. Schultz and Donald Folsom. The general purpose of certification, as understood by these persons and as expressed by Orton in 1913, was to improve the quality of potato seed stocks. When research disclosed facts and principles that suggested new ways of improving seed quality, their practical application was worked out by the State certification inspectors.

Few marked changes from 1925 to 1955 have occurred in the requirements. The time of roguing is now up to the grower. Ring rot is referred to and has a zero tolerance. Certified foundation seed is recognized if passing a winter Florida test for a tolerance of one-half per cent total virus disease.

One of the papers on the Early History of Seed Certification in North America.

POTATO PRODUCTION VS. PRICES

A Breakdown of The Chart on page 35.

Year	Annual production in bushels (approximate)	Price to farmers per bushel (approximate)
1930	340,000,000	$1.00
1931	400,000,000	.65
1932	375,000,000	.40
1933	340,000,000	.80
1934	400,000,000	.50
1935	390,000,000	.60
1936	330,000,000	1.25
1937	380,000,000	.60
1938	350,000,000	.65
1939	340,000,000	.70
1940	375,000,000	.60
1941*	350,000,000	.75
1942*	365,000,000	1.00
1943*	430,000,000	1.25
1944*	400,000,000	1.50
1945*	410,000,000	1.40
1946*	470,000,000	1.25
1947*	400,000,000	1.60
1948*	420,000,000	1.60
1949*	400,000,000	1.00
1950*	410,000,000	.90
1951	325,000,000	1.60
1952	340,000,000	2.00**
1953	380,000,000	.80
1954***	355,000,000	.90

* War and support years.

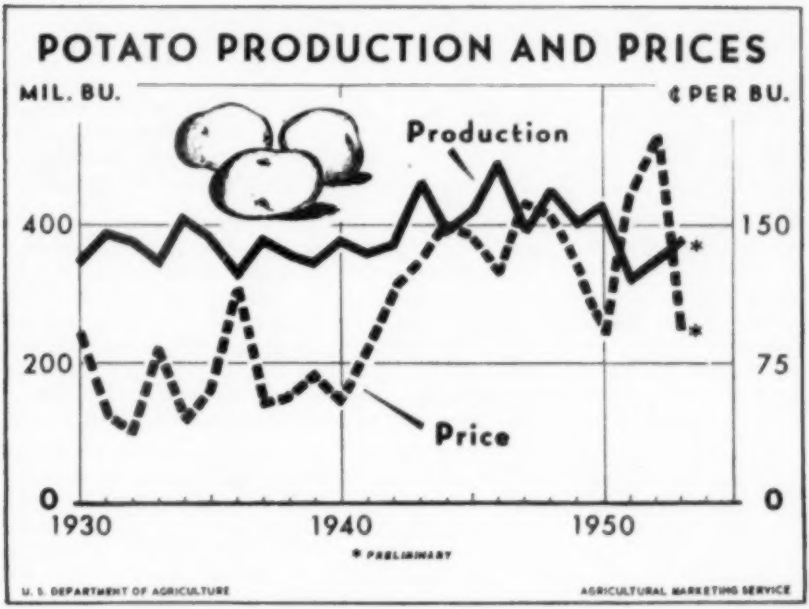
** The price per bushel varies somewhat due to the overlapping of years of poor price and years of good price and vice versa.

***Not taken from the chart.

Why not profit from this historical production and price review and never overplant?

EFFECT OF INCOME ON POTATO CONSUMPTION

Purchases of white potatoes increase up to $4,000 family income — then decrease. — Middle-income families use more potatoes than urban families with either lower or higher incomes. In the spring of 1948 city families throughout the country with incomes of $3,000 to $4,000 used about 15 per cent more white potatoes per person a week than families with incomes between $1,000 and $2,000. Families in the $5,000 to $7,500 group, however, used 20 per cent less than the middle income families, and about 10 per cent less than the $1,000 to $2,000 group.



PROPER STORAGE AND HANDLING OF SEED POTATOES

CECIL FRUTCHEY

Colorado A & M College
Fort Collins, Colorado

Nearly all certified potato seed in the United States and Canada is worthy of the highest praise and recommendation; well grown and well rogued, only a trace of virus diseases occuring in most of it. So it behooves everyone concerned with the certification of seed potatoes; the inspector, the grower, the dealer, and the buyer to do everything possible to see that it is well cared for between harvest and planting time. It is a long time from the second field inspection until planting time the next year; and a lot of things can happen, most of them unfavorable.

The inspectors are well acquainted with this problem of care after growing. Every year they see seed lots misused at harvest time and later on, after receiving excellent care during the summer. The rough handling, poor storage, and poor sorting can make inferior seed out of a product that was high quality and free from disease when harvested. The inspector can rather easily disqualify seed that barely meets the minimum standards during field inspections. It is much more difficult to disqualify seed that barely meets the grade standards.

Each year there are a minor number of complaints from buyers, about

excessive sort out at seed cutting time and poor stands due to rapid seed piece decay. Most of this is due to poor management after harvest. The grower is usually blamed for this whether or not he was responsible. Often it is his fault. However, it is not an uncommon occurrence for a buyer to purchase good seed, well grown, well stored and sorted, carefully delivered and then ruin it by improper care after he receives it. The following points will help to explain the need for careful storage, sorting and handling in order to bring about the best performance of the seed when it is planted.

1. Care at harvest time — The major part of the seed potatoes are grown in cool climates with relatively short growing seasons. For these reasons they are likely to be somewhat immature and to be easily skinned; also due to immaturity they are likely to be highly turgid and easily bruised. Vine killing early, to avoid late season spread of virus diseases likewise tends to leave the tubers immature. These are not necessarily disadvantages. Often the comparative response and early vigor shown following planting, is strikingly noticeable of seed grown in short season areas. Yet this tendency toward immaturity calls for special care to avoid storage rots and to maintain quality.

2. Rots — Storage rots can be classified into two general types, the wet rots, and the dry rots. The wet rots may be due to any number of diseases; late blight, blackleg, the soft rots, and the leak type diseases and usually destroy a tuber quickly and completely. They can be dried up and prevented from spreading to healthy tubers by dropping the temperature to 40° F. as quickly as possible and keeping the humidity as low as possible. The dry rots are much slower acting and ordinarily cause little trouble unless the tubers are skinned or bruised. Holding the potatoes at higher temperatures and humidity for the first two weeks of storage will help heal the skinned and bruised areas and reduce the amount of dry rot when the temperatures warm up toward spring. Therefore it can be seen there is a definite conflict between the control of wet rots and the control and prevention of dry rots. Some years ago it was the recommendation to keep the storage warm until the immature tubers had healed. This is still a good recommendation unless wet rots are present in the field at digging time. Then both the temperature and humidity should be dropped. The early control of storage temperature and humidity and the consequent control of rots are exacting ones. The buyer who buys his seed in the fall and stores it should be especially cognizant of this fact. Of the wet rots, soft rot is the virulent one. It is nearly always associated with the other wet rots and may, with temperatures of 75° F. and humidity of 90%, completely rot a bin of potatoes in two or three weeks.

3. Sorting and sizing — Since the table stock market usually pays a premium for the larger potatoes it is much better to sort them out of the seed rather than to attempt to include all the large ones the regulations will allow. One and one-half inch to nine ounces makes a nice seed pack and usually wins customers. The other reason for sorting is to remove the rots, culls and off-grades. Even the smallest rot spot should not be overlooked, for it can quickly grow into a large one. Growers who sort their own seed early in the winter should pay particular attention to this. Standing in a cellar in sacks for a month or so after sorting certainly doesn't enhance the quality of the seed. Reference to this is so obvious as to seem rediculous, but nevertheless it causes more poor seed packs and dissatisfid customers than any other practice undertaken by the seed grower.

The sorting of seed by the dealer in a commercial warehouse should receive special mention here. The seed may be excellent, disease free, of good quality, firm and with very little rot of any type; then suddenly it is contaminated with ring rot. It still looks good; neither the dealer, nor buyer, nor inspector, can see anything wrong with it at the time, but the next summer the plants will show anywhere from a trace to 50% infected with ring rot. Fifty per cent infections of this type are not a rarity, particularly if the sprouts are beginning to emerge from the eyes at sorting time. Using a sorter or de-sprouter that has not been disinfected is just like swabbing a cut finger with pus instead of iodine. The only difference is that ring rot takes about eighty days from planting time to become apparent, and the cut finger is badly infected after two days.

4. Care in handling — Since seed potatoes are usually stored at colder temperatures (35° F.) than commercials, they are more turgid and more easily bruised and shattered during handling. Examples have been known of a buyer backing his truck into a seed growers cellar or cold storage plant, taking potatoes from 35° F. temperature, throwing them onto the truck or dropping them waist high from a loader, taking them home and dumping them onto a concrete floor at home and then complaining a few days later about the tremendous amount of shatter bruising. A turgid potato will break about as easily as a paper bag filled with water.

Also since the spring buyer usually stores the potatoes in warmer temperatures (50° F. - 60° F.) the newly formed bruises and breaks affords an excellent opportunity for rot organisms to invade. By the time the potatoes are cut a week or two later considerable rot may be showing. This is not the fault of the grower unless he delivers the potatoes and is careless in handling them.

5. Care in cutting and planting — Very few sound seed pieces rot in the ground before the plants emerge. Most of the seed that rots quickly has begun to decay before it is planted. Much of this trouble can be avoided at cutting time. Like the healing and curing period after harvest, cut seed heals more quickly at higher temperatures and high humidity. But high temperatures and humidity favor the development of rots. So again a critical decision has to be made. Usually a happy medium can be found which will heal the cut surfaces firm and sound without rotting. Bright sun and dry winds are very detrimental to freshly cut seed. It is better to plant freshly cut seed if that is possible. It will ordinarily heal better in moist soil than in the air. If it isn't possible to plant it freshly cut, then the next best practice is to cut the seed well ahead, allowing it to heal completely before planting. The most critical time is three or four days after cutting. At that time the rot organisms are present trying to invade, and the cut surface is trying to lay down a cork layer to prevent invasion. Planting at that time seems to favor the rot organisms.

The main considerations are: mature the plants as well as possible before digging; dig carefully to prevent bruising and skinning; store at cool temperatures of medium humidity; sort well just before delivery; handle carefully to avoid bruising and shattering; and cut so that the cut surface will heal and not rot.

CERTIFIED SEED FOR SALE

C. A. Powers & Company
Specializing in Seed Potatoes
Owners and Operators of
Powers Farms Inc.
Fort Fairfield, Maine.

Henry Normandeau
Ronan, Montana
Netted Gem, 7,500 bus.

Atlantic Traders Ltd.
514 Bank of Nova Scotia Bldg.
Halifax N.S., Canada
Bliss Triumph, Sebago and Keswick

McDonald & Starbuck
Monta Vista, Colorado
Russet Burbank, 5,000 bus.

Irvine & Cotton Co.
Dillon, Montana
Netted Gem 50,000 bus.
White Rose 50,000 bus.

Abe J. Dubay
Polson, Montana
Netted Gem 12,000 bus.

Walter Mangels & Son
Polson, Montana
Netted Gem

Northern Seed Potato Co. Ltd.
615 Providence Bldg.
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Vancouver 4, B. C.
Specializing in Netted Gem,
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S. Nightengale & Co.
Growers and Shippers of
seed and table potatoes.
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Cobbler, Katahdin
Chippewa, Kennebec
Sebago, Sequoia
Green Mountain
Cherokee, Bliss Triumph
and Russet Burbank

Crescent Ridge Farm
Leslie M. Merwin
Fillmore, N. Y.
Katahdin and Ontario

Ed Dubay
Polson, Montana
Netted Gem 9,000 bus.

FARR FARMS COMPANY

GREELEY, COLORADO
LA SALLE, COLORADO

Seed Potatoes – Commercial Potatoes

Red Pontiac — Katahdin — Russet Rural
Bliss Triumph — Early Gem

Russet Burbank Bakers
A Specialty

OFFICIALS AND AGENCIES IN CHARGE OF POTATO SEED CERTIFICATION

California

H. W. Poulsen, Chief and John J. Adams, Supervising Inspector, Bureau of Fruit and Vegetable Standardization, Dept. of Agriculture, Sacramento 14, Calif.

Colorado

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Delaware

Robert Hickman, Delaware State Board of Agriculture, Dover, Del.

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Vermont

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NEBRASKA STATE

CERTIFIED SEED POTATOES

•

America's Storehouse of Superior Varieties

Performance
Color
Uniformity

•

RED VARIETIES		WHITE VARIETIES
Triumph	Dazoc	Cayuga
LaSoda	Sheridan	Early Gem
Red Pontiac	Redglo	Kennebec
Red Warba	Progress	White Rose
		White Cloud

•

For Information, Write or Wire

POTATO CERTIFICATION ASSOCIATION OF NEBRASKA

P. O. Box 90

ALLIANCE, NEBRASKA

NEBRASKA SEED POTATO CERTIFICATION

Seep potato certification was established in Nebraska in 1919, by the Horticulture Department of the College of Agriculture. The department continued this function until 1924, when a growers association was formed for the purpose of conducting the work. All regulatory functions of inspection and certification of seed potatoes has continued under this arrangement since that time. Such work is conducted under the authority of the Agricultural College, as required by Nebraska State law.

Production of potatoes in Nebraska is principally by small or medium sized growers. This situation has been true since the early years of certification. There is a strong personal pride in this type of grower, which results in a constant production of uniform, high quality seed potatoes.

The aim of seed potato certification is to produce and make available supplies of seed tubers that are (1) true to variety and type, and (2) free from disease. A low tolerance of disease is maintained by almost constant examination of fields entered for certification by a staff of experienced inspectors. The application of high standards guarantees close compliance with the factors mentioned above. In addition to field inspections, the harvested tubers are examined in the cellar before grading or sale. A final inspection occurs after grading and just before shipment, at which time the stock is considered as Official State Certified seed potatoes.

The basis of a successful certification system is an effective foundation seed program. Nebraska has a well organized foundation seed production set-up that is financed by the growers themselves. They have employed recognized authorities in the field of disease detection, who are constantly striving for perfection in the primary seed stocks produced. Intensive and extensive field trials are conducted, both in Nebraska and in southern states. In addition to maintenance of standard varieties that are in demand, new varieties are constantly being added for special purposes and for the improvement of the industry.

One of the most extensive Potato Breeding projects in the United States has been conducted by the Nebraska Agricultural College. Dr. H. O. Werner, Horticulturist, in charge of the breeding work, has an international reputation in the field. One of the principal objects of the program is to produce varieties that will increase the potential production under southern conditions. Special emphasis is placed on improving culinary quality, and increasing resistance to damage of all forms to improve the final product that is delivered to the American housewife.

As new varieties are released by the Agricultural College, foundation stocks are built up. These in turn are produced commercially by the certified potato grower, for the table stock industry. All phases of seed potato production are closely integrated in Nebraska to produce a product of uniformly high quality for the seed buyer.

COLORADO CERTIFIED SEED POTATOES

— NO BETTER GROWN —

All The Major Varieties

Many Minor Ones

A TOTAL OF 20 IN 1955

A Certified Field in Colorado

Certification is supported by a
FOUNDATION and INDEXING PROGRAM

For Complete List
of Growers, Dealers and Seed Supplies

Write to:

POTATO CERTIFICATION SERVICE
COLORADO A & M COLLEGE
FORT COLLINS, COLO.

NEW VARIETIES IN COLORADO

Like all other states and provinces, Colorado is constantly searching for new and better varieties. In that regard the State is fortunate in having a Federal Horticultural Experiment Station located at Greeley. This is in the heart of the Northern Colorado potato area. About 10,000 individual seedlings are tested there each year, and those few showing promise are further field tested out over the State.

Both white and red varieties are in the program and a pattern of testing has been established and is being adhered to rather closely. This is being done in an effort to avoid the releasing of varieties which may show up well in one character and be entirely undesirable as to other characters. The following tests are used as a means of elimination:

1. Scab resistance: Due to the highly alkaline nature of most Western soils, a great deal of emphasis has been placed on scab resistance, and some of the best scab resistant parent material is now available at the Greeley Station. The testing is by both scab-plot testing and the Ferric Chloride method of eliminating the highly susceptible ones. Recently, scab resistance of a rather high degree has been incorporated with red color and a few scab resistant reds are being tested.

2. Quality: The ability of a variety to produce a high percentage of smooth good appearing No. 1 potatoes is necessary for good market quality. In the reds this must also include good color. Quality must be easily attained in a variety, otherwise it is useless to hope it will come into standard production. Unless a variety has some superb quality there is little hope for it if it carries any degree of poor quality. An example of this is the Russet Burbank potato. It is superb in baking quality; it is relatively scab resistant; it has a good skin; and ships and keeps well. Other than that it is a very poor variety, suffering from jelly-end rot, Verticillium wilt, leafroll and net necrosis, and is exceedingly costly to grow. If it were in a new variety plot today, it would be eliminated the first year of testing. So, the standards are very exacting on new varieties.

3. Specific gravity and the ability to make good potato chips: A variety that would chip as well as Russet Rural and still be more acceptable to the trade as a fresh potato is highly desirable. Every white variety is tested for specific gravity and its ability to chip. Unless they test at least 1.085 they are discarded. Also they must produce a good quality of potato chips. These qualities vary from field to field and year to year depending on conditions. But unless a variety consistently measures up well, it is discontinued.

4. High yields: Today the cost of production is so high that unless a variety will yield 300 sacks (500 bushels) per acre on irrigated land, regardless of quality or other characteristics, it will find little popularity among growers. All varieties are subjected to the acid test; yielding ability.

5. Resistance to virus diseases: This is considered, not because virus diseases are a big problem to commercial growers, but because such virus diseases as spindle tuber, leafroll and the mosaics are the nemesis of all potato growers. Seed certification programs and insect control are so well developed that varieties carrying high susceptibility may be grown successfully, commercially; yet if a new variety shows extreme susceptibility to any of the viruses, it is discarded.

WINTER TESTING OF SEED POTATOES – RETROSPECT AND PROSPECT

GEDDES W. SIMPSON
University of Maine,
Orono, Maine

Winter testing of seed stocks has had a positive influence on the quality of the seed planted in the Northeast and later sold from this area. It made a major contribution to the industry during the years between 1937 and 1946 when leafroll was a major problem. This contribution was twofold; it showed what tested stocks were too badly infected to be replanted and permitted growers to discard them — which they might not have done without advance information; and secondly, it has indicated the best stocks available for further propagation. There is ample reason to believe that the information from successive tests has been a major factor in improving the quality of seed used locally as well as that exported to other areas. Without such a test it is entirely possible that it would have taken a much longer period of time to recover from the leafroll epidemic of 1937.

Buyers of certified seed have been able to secure advance information on some lots of seed for at least 35 years. For perhaps the first 20 of these years no large volume of seed was winter tested but since the outbreak of leafroll in the Northeast in 1937, a much larger volume of seed has been tested, not only in the Northeast but in Canada and the Midwest as well. This increase came about gradually as more states became interested in the possibilities of winter testing and its effect on the general quality of the seed stocks available in each area. During the war years, the acreage tested was abnormally high, due to artificial price regulations. Such situations often result in rapid changes that may be comparatively short-lived. Since that time, the volume of seed tested has been less but it has been fairly constant.

Winter testing of seed stocks grew out of the finding that virus diseases were spread by aphids. Much of this information became available before 1920 but it did not begin to affect certification practices and grower routine until shortly after that year. Some of the early plantings of test lots of seed potatoes were made in Bermuda and later in northern Florida, but since the time soil scientists first found that the addition of manganese to the soils of southern Florida permitted potatoes to grow there, most of the testing has been carried out in that area. Normal freedom from frost and an earlier planting season favor this location for winter testing of seed samples.

Large-scale winter testing of Maine seed stocks grew out of the excessive leafroll content of the 1937 seed and table stock crop. At that time a large percentage of the acreage was planted to the Green Mountain variety — a variety susceptible to net necrosis, a symptom of current season leafroll infection. A few years later, testing of seed stocks of the Chippewa variety became mandatory because of the rapid spread of the same virus in stocks of this variety. The volume of seed being tested increased rapidly as the industry attempted to find seed suitable for replanting in spite of continuing spread of the leafroll virus. It should be remembered that this large-scale testing was possible only because a reliable process for breaking dormancy by means of ethylene chlorohydrin was available. Had this not been possible, disease readings might well have been delayed beyond the time when they could have been of much help to growers needing to locate better seed stocks.

As winter testing of seed stocks has evolved in this area, it is concerned mainly with a determination of the amount of several virus diseases present — leafroll, various mosaics, and spindle tuber — and with the ever present problem of varietal mixtures. There have been a few occasions when ring rot has been found as the samples were being processed prior to treatment for breaking dormancy, but the size of the sample in relation to the total volume of tubers being tested has been such that field inspections must be relied upon for detecting infection with the ring-rot organism.

Percentage determinations of virus diseases and varietal mixtures have been surprisingly accurate when samples have been properly taken at harvest time and have been limited to areas of 20 acres or less. Present practice requires 800 tubers, taken at random as the seed is hauled to storage, to represent each lot tested. Dormancy is broken using ethylene chlorohydrin released in warm, fairly gas-tight, rooms. Samples are treated in late October, shipped to Florida in early November, and planted by early December. Readings are returned to growers by mid-January in plenty of time for them to take full advantage of the information before a new crop is planted in May or June.

At no time in the years the test has been available to Maine growers have any large percentage of certified seed growers taken advantage of the opportunity, and few, if any, table stock growers have submitted samples. However, because of the geographical distribution of the samples actually tested, it has been possible to assess, rather accurately, conditions in the whole area, and the general results of the test have been used by many more growers than have seen fit to secure accurate information on thir own seed stocks. The influence of winter testing has thus extended considerably beyond its physical limits.

Seed growers find the information from a program of winter testing of value from the standpoint of prospective sales, as well as from that of their own interests. It is sometimes difficult to separate these aims, except perhaps on the basis of the acreage being tested in relation to the total acreage being planted by individuals using the test. Any self supporting program must return something over and above its actual cost in time and money to those who use it and time and money must be expended during a busy harvest season if samples are to be obtained for testing. That many growers have entered samples in successive tests over the years is ample proof of their satisfaction with the results of the testing program.

Past experience suggests that winter testing of seed stocks is a valid part of the over-all picture of seed certification. It helps materially in assuring that the location of the best seed available is known to seed growers who need or wish to acquire new, more healthy stocks. Over the years it has helped to improve the quality of all the seed being planted in this area. It has been a factor in keeping the very best seed in the area where it can be further multiplied before being exported. There is reason to believe that it has also materially improved the quality of the table stock seed being planted and to that extent has made it easier to maintain certified and foundation seed stocks in the area.

With the advent of DDT and of the organic phosphate insecticides for the control of aphids, the need for winter testing is less acute than it was 15 years ago — a fact reflected in the reduced acreage represented in the test today. There are, however, still values sufficient to attract the support of some 250 growers this year.

At the present time, there are other possible ways of detecting leafroll — or rather determining that individual tubers are free of leafroll, but there is no other way known to mass test for other virus diseases or for varietal mixture. Until such tests become practical, winter testing of seed stocks is likely to continue to merit the support of the most conscientious seed growers.

A FEW NOTES ON INSPECTION AND CERTIFICATION OF SEED POTATOES IN MICHIGAN

H. C. Moore
Michigan State University

Potato seed certification was started in Michigan in 1920. Prior to that time, fields were heavily infested with leaf roll, curly dwarf, and spindle sprout. Also it was almost impossible to find fields free of varietal mixture. The varieties most generally grown were Russet Rural, White Rural (Rural New Yorker #2), Early Ohio, Irish Cobbler, Green Mountain and Triumph.

For four or five years before certification was started, much of the work was done through Extension in getting growers to use seed plots and practice hill selections. By 1920 we had about 70 growers who undertook the production of seed for certification. The average yield per acre that year was 138 bushels, compared with 105 bushels the state averaged for all fields. Our disease tolerance was then 10 per cent and our rejections were approximately 30 per cent. Nearly 90 per cent of our fields listed for inspection were of the Russet Rural variety. Other varieties included Green Mountain, Irish Cobbler, and White Rural.

The Michigan Potato Producers Association, Dorr D. Buell, President, was the organization that sponsored the seed work for the first four years. Since that time the work has been carried on by the Michigan Crop Improvement Association under the supervision of the Extension Service of the Michigan State University.

Certification has played a very important part in Michigan in the control of virus diseases, and especially in that of yellow dwarf which in 1933 to 1935 caused severe losses to Michigan growers. This trouble was worse in the central area of the lower peninsula. By bringing in many carloads of certified seed from northern counties and by maintaining a very low tolerance for yellow dwarf, growers were able to produce very satisfactory potato crops in the badly infested areas.

In addition to the regular field bin and carload inspections, Michigan maintained test plots comparing the samples from all certified seeds to determine the effectiveness of the inspection work. Such tests have been continued since 1920 within the state and since 1933 in Florida, Texas, and Alabama.

Our acreage of certified seed increased from 192 acres in 1920 to 4,000 acres in 1929. Since that time the acreage has declined to about 2400. The number of growers has also dropped from 1825 to some 125. Yield per acre, however, has increased about three times compared with what it was in the beginning so that our annual total production of certified seed is now approximately 640,000 bushels.

One of the papers on the Early History of Seed Certification in North America.

TREATING CUT SEED POTATOES WITH CATECHOL

LAWRENCE A SCHAAL, *Pathologist, U.S.D.A.*
Colorado A & M College,
Fort Collins, Colorado

The use of phenolic compounds to stimulate the formation of suberized tissue on the cut surface of potato seed pieces was a by-product of research on the nature of scab resistance. Chlorogenic acid is associated with scab resistance and it is a penolic compaund. It was noted that when pure chlorogenic acid was applied to the fresh cut surface of a tuber, a very tough protective layer of suberized cells formed rapidly. Since chlorogenic acid is very expensive, several less expensive phenolic compounds were found to produce the same result, — a layer of suberized cells. A relatively cheap phenolic compound, catechol, was found to be very effective. The C.P. grade of catechol contains undetermined amounts of free phenol that can cause injury, hence it is advisable to use the resublimed grade. The resublimed grade of catechol is readily soluble in water at a concentration of fifteen hundredths of one per cent (.15%) and is the recommended concentration for treating cut seed. Fresh cut seed pieces are dipped, drained immediately, and allowed to dry, they can then be stored in one-half sacks or crates for periods of one month or longer providing storage temperatures are kept between 40° - 50° F. The catechol stimulates the production of suberized cells on the cut surface (Figure 1) and also reacts with the enzyme tyrosinase present in the tuber tissue to produce quinones that are extremely toxic to fungi and bacteria. The stimulation of the production of suberized cells starts immediately after treating and a tough, pliable layer of suberized tissue gives the cut surface a brown velvety appearance. This protective layer does not crack or readily sluff off, affording effective protection. Since any liquid seed treatment of cut seed is less desirable than a dust treatment, experiments are being conducted to determine a method of formulating finely ground resublimed catechol with a carrier, such as talc.

FIGURE 1.—Photomicrograph showing suberized cells on catechol treated and untreated cut potato seed pieces after four days.

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Boise, Idaho

SEED POTATO PROGRAM IN IDAHO

In 1955, Idaho had 558 growers entering 12, 412 acres of potatoes for certification. Ninety eight per cent of this acreage is the Russet Burbank (Netted Gem) variety. Inspection and certification of all crops in Idaho is the responsibility of the Idaho Crop Improvement Association. Competent inspectors make a minimum of two field inspections. If the season permits, a third inspection is made of a large percentage of the fields.

Tolerances for disease are very strict. After the seed has been harvested there is a storage inspection at which time a representative 600-tuber sample is taken from each grower's lot. Half of this sample is treated to break dormancy and taken to California where it is planted early in December. Normally, readings on these winter test plots are obtained by the first of March.

Disease tolerances are established for the winter test plots. Those lots exceeding the tolerances are eliminated from the certification program and the grower is advised to obtain new stock.

The other half of the grower's lot is kept at the Aberdeen Experiment Station where it is planted early the following spring. This procedure gives an additional check on each seed lot and is very helpful to the inspectors just prior to beginning first inspection.

To help maintain disease free seed and to provide certified seed growers with a source of disease free seed, the University of Idaho in cooperation with the Idaho Crop Improvement association maintains a foundation seed farm. This year foundation stocks of Russet Burbank, Early Gem, Kennebec and several promising new varieties were grown with maximum care and isolation.

Before a variety or seedling is entered into the foundation plantings each tuber must be indexed. Tuber indexing is done in the greenhouse at the Aberdeen experiment station and in conjunction with the winter testing program in California. In addition, each year from one fourth to all of a variety or seedling that is to be further increased as foundation planting is tuber-indexed to give additional assurances of disease freedom before being released to seed-potato growers. The decision as to which variety shall be increased and how much of that variety shall be tuber-indexed each year is made by a foundation seed committee which has representatives from the industry, Idaho Crop Improvement Association and the University of Idaho.

In 1949, a cooperation potato-breeding project was initiated by the University of Idaho and the United States Department of Agriculture, the chief purpose of which was to incorporate resistance to verticillium wilt into the russet-type potatoes. Some very promising resistant seedlings have been developed by using resistant parents in crosses. Types with a russet skin and adequate resistance to verticillium wilt have been developed by crossing resistant parents with susceptible russet-type potatoes. Additional work is being done on resistance to virus diseases, with particular emphasis on leaf roll.

IDAHO POTATO PACKING COSTS

Why is the packing labor bill higher when potatoes are poorer?

More potatoes have to be handled for the same end-product. Potato-packing costs rise as potato quality becomes poorer.

Can a packer afford to pay a premium for good potatoes?

Yes, good quality potatoes would be more economical to pack. It would pay him to offer a premium for high quality potatoes.

MONTANA CERTIFIED SEED POTATOES

Netted Gem
Bliss Triumph
White Rose
Progress
Early Gem
Katahdin
Kennebec
Pontiac

Foundation, Blue Tag, and Red Tag

- 3 field inspections, 1 bin inspection
- in addition a foundation and greenhouse index program
- grade inspection by Federal and State regulatory staff

For a Complete List of Growers

Write to:

Mr. Leonard A. Yager, Secretary-Treasurer
Montana Potato Improvement Association
Montana State College
Bozeman, Montana

NETTED GEM FROM THE LAND OF SHINING MOUNTAINS

Montana Foundation and Blue Tag seed producers of Netted Gem take pride in presenting as fine a type of disease-free potato tubers as found anywhere. Growers and buyers from outside of the state have been amazed at the many acres of uniform, disease-free vines in these fields. Our growers work in close cooperation with members of Montana State College to maintain this high reputation. The tuber index program conducted during the winter months at Montana State College coupled with careful tuber unit and hill unit selection maintained by our foundation seed growers have been responsible for this high-quality seed. Careful and timely roguing by our growers has been no less responsible than these other methods. One of our more troublesome virus diseases in recent years has been mosaic, but this has been almost eliminated by this program. Spindle tuber and leaf roll virus are practically non-existent in these seed lots.

Western Montana Netted Gem seed producers work hand in hand with nature to produce these beautiful crops. Good isolation of fields, high altitudes above 3,000 feet, a wealth of sunshine, cool nights during summer months, abundant irrigation water and a low population of troublesome insects make conditions in western Montana ideal for the production of high quality, disease-free foundation seed.

Our foundation and blue tag seed growers have paid considerable attention to the selection of a good type Netted Gem. This good type seed produces tubers of attractive shape, free from disease and with good netting of skin. Experiments are now being conducted at Montana State College to determine whether high specific gravity is carried over in the seed as an inherited characteristic or whether it is a local product of soil and weather conditions. Tests show that Montana grown Netted Gem tubers are high in specific gravity. Since high specific gravity is directly related to high starch content, and hence greater mealiness, this has a direct bearing on quality.

Please do not overlook the fact that smaller quantities of other varieties are available in this state. Some of the other seed varieties are White Rose, Bliss Triumph, Pontiac, Kennebec and Early Gem.

Montana growers are always proud to show their excellent seed to prospective growers and buyers. To see these clean, healthy, productive fields is a conclusive selling point. Montana is a wonderful vacation land as well as the source of some of the nation's best Netted Gem and White Rose seed. Why not plan your next vacation and buying trip into Montana's Land of Shining Mountains? If you are prone to good hunting and fishing, we are in a position to offer the finest facilities for that, too! There's good hunting with a camera, too!

LABOR NEEDS FOR PACKING POTATOES

How much more labor does it take to pack in 10-pound bags than in 100-pound burlap bags?

About twice as much.

How can a packer reduce costs in 10-pound packing operations?

Employ a higher percentage of women workers. They can handle 10-pound bags as efficiently as men. Arrange plant more efficiently.

THE SEED YOU PLANT
IS IMPORTANT

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MINNESOTA
CERTIFIED SEED POTATOES

are grown under rigid requirements and inspected by well trained qualified inspectors of the State Department of Agriculture to see that these requirements are met

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HIGH QUALITY SEED STOCK
of the
FOLLOWING VARIETIES

Bliss Triumph	Kennebec
Cherokee	LaSoda
Early Ohio	Redkote
Irish Cobbler	Red Pontiac
Red Warba	Russet Burbank
Waseca	Sebago
Chippewa	White Rose

Grown from foundation or approved seed.
Florida or Greenhouse tested.
Thoroughly field inspected.
Stored properly.
Shipments inspected for grade by Federal-State Inspectors.

A Complete List of Growers
Available on Request

STATE OF MINNESOTA
DEPARTMENT OF AGRICULTURE

SEED POTATO INSPECTION AND CERTIFICATION
St. Paul Campus — University of Minnesota

PERFORMANCE OF NEW POTATO VARIETIES IN MINNESOTA

Each year, potato variety demonstration plots are conducted in the leading potato growing areas of Minnesota. These plots afford the growers an opportunity of evaluating new and old varieties from the standpoint of both seed and table stock production. With the ever-increasing number of new varieties appearing from State and Federal Experiment Stations, growers are often in a dilemma in selecting varieties for planting. A few comments on some of the varieties that have been promising in these demonstration plots are as follows:

Waseca — An extra early red variety showing a definite improvement over Red Warba in market quality. Although the tuber color is pale red, the eyes are shallower than those of Red Warba. The thick skin makes the variety well suited for early market. It produces a low set of tubers, practically all of which meet the U.S. No. 1 size standards. The tubers are round to oblong and medium thick.

Early Gem — A new early russet variety with resistance to common scab. The tubers are medium long and shallow eyed. In Minnesota, the dry matter has been about equal to Red Pontiac but considerably lower than Russet Burbank. It appears to be well suited to the light soils, especially where irrigation is available. Where growing conditions are irregular it is not uncommon to observe a high percentage of growth cracks and second growth tubers in this variety.

Osage — An early white variety with good resistance to common scab. Tubers are long, cylindrical, and somewhat flattened. The eyes are shallow and the skin smooth. This variety has excellent market and cooking quality, but under certain conditions it produces serious hollow heart.

LaSoda — A medium early red variety with good market and culinary quality. The tubers are round to oblong with medium shallow eyes. The skin is smooth and bright pinkish red. It has been one of the highest yielding varieties in demonstration plots during the last three years. Recently a red sport of this variety was found. The plant and tuber characteristics of the Red LaSoda are identical with those of LaSoda except for the more intense dark red tuber color.

Cherokee — A white midseason variety with a combination of scab and late blight resistance. Recent tests have indicated that it is susceptible to some of the strains of late blight however. It appears to be field immune from mild mosaic and somewhat resistant to net necrosis. The tubers are round to oval and flat to fairly plump. A distinguishing characteristic is the flat to slightly concave surface on the dorsal side of the tubers. The skin is bright ivory white and appears to resist bruising and abrasion. The tubers have been consistently high in total solids which indicates high cooking quality. It is especially well adapted to peat or muck.

Kennebec — A white midseason variety with resistance to some strains of late blight. The tubers are elliptical to oblong with shallow eyes. Although the vines are green up to frost, the tubers usually set before those of the Irish Cobbler. Unless planted close and the vines destroyed at the proper time, many oversize and rough tubers may develop. It is one of the highest yielding varieties of good culinary quality. It is an excellent chipping variety.

Redkote — A new red midseason variety with attractive market quality and scab resistance. Tubers are round to slightly oval and medium thick. The eyes are very shallow and are encircled with a light pink halo, a characteristic which helps to distinguish this variety.

STOP ROAMIN' • BUY WYOMIN' CERTIFIED SEED POTATOES HERE ARE REASONS WHY ! !

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Wyoming's Certification Program is Aided by a Foundation, Indexing, and Winter-testing Program that makes Wyoming Certified Potatoes as

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From This Variety List, One or Two Will Surely Fill the Bill for you

1955 — CERTIFIED VARIETIES

Bliss Triumph	**LaSoda**
Red Pontiac	**Redglo**
Netted Gem	**Early Gem**
Progress	**Sheridan**

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Wyoming Seed Certification Service

Agronomy Department
University of Wyoming
Laramie, Wyoming

POTATO IMPROVEMENT AND THE QUEST FOR SUPERIOR VARIETIES

Research work conducted at the University of Wyoming has for many years been aimed at improving the potato crop grown in the state and elsewhere. Many approaches are made to the problem of potato improvement. Plant breeding is employed in which every year hundreds of new potato seedlings are obtained. The new potato seedlings undergo a vigorous testing program in which they are screened for yield, growth habit, cooking quality, eye appeal, disease resistance and market qualities. This search for a new variety, superior to all others, has been primarily for a new red skinned potato but at the same time not overlooking the white skinned potatoes that show definite promise.

It was through such a research program that in the mid nineteen forties, Wyoming named and released the Teton variety of potatoes in cooperation with the USDA. It was found that a seedling, which was later named, Teton, was highly resistant to ring rot. Teton is still one of a very few potato varieties resistant to ring rot and has increased to considerable acreage in the east. Wyoming furnished the original foundation and certified seed stocks for the increase in the east.

At the present time Wyoming is testing a number of very promising red skinned potato seedlings. These seedlings are undergoing yield tests, disease resistance tests for scab and ring rot, cooking quality tests, desirability of vine and tuber tests and market quality tests.

While the Wyoming research program is searching for that new superior variety, it is also working to improve the named varieties already at hand. A rigorous potato seed certification program endeavors to keep available to the public the highest quality seed potato stocks possible. The rigid certification standards, coupled with a foundation seed program, tuber indexing in the greenhouse, tuber uniting in the field and a winter testing program in the south, provides the commercial potato grower with dependable seed potatoes. Wyoming's certified seed potatoes are inspected two times during the growing season in the field by qualified inspectors especially trained for the work. In order to pass these two field inspections Wyoming's certified seed fields must meet standards which in many cases are twice as strict as the minimum standards in use by the International Crop Improvement Association. Certified seed potatoes which have met the field inspection standards must still meet the bin inspection requirements. With a zero tolerance on ring rot only fields and bins of potatoes found free of this disease are finally passed as certified seed. Only the grower who has produced certified seed potatoes that can meet these strict standards in field and bin inspections is eligible to receive the certified seed tags with which to tag his fine product. The commercial potato grower who purchases and plants Wyoming blue-tagged certified seed potatoes has put his best foot forward and is well on the way towards a good crop.

Plant

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EARLY HISTORY OF SEED POTATO WORK IN WISCONSIN

H. M. Darling
University of Wisconsin

Potato improvement work in Wisconsin started about seventy years ago when the Experiment Station of the University conducted experimental variety trials. It was not until 1889, however, that Professor E. S. Goff of the Horticulture Department demonstrated the principle that vigor of the potato plant could be maintained and increased by selection. From his early studies he made recommendations to "grow a plot of potatoes each year on the best soil, to be used expressly for seed selection, and dig this plot by hand. The selected tubers from this plot could be used next season to produce seed for the main crop the following year. This is substantially the method practiced by seed growers in maintaining vigor and purity of their seeds."

This work was followed by that of Professor J. G. Milward in 1905, also of the Horticulture Department, who made substantial progress in eliminating many of the varietal mixtures and the numerous trade names used for the same variety. He also emphasized the need for developing seed stocks by carefully selecting and marking typical and productive hills during the summer and reserving this seed separately for continued selection. By following these procedures, he clearly demonstrated that varital mixturs could be eliminated and that healthy, vigorous seed resulted. Equally important, it was realized that those procedures could be used by many growers with but few adaptations to increase the volume of a seed stock rapidly. To provide the basic seed stocks for this program, approximately 150 bushels of selected seed were distributed in 1911 and sixteen acres were grown for distribution the following year.

It now remained to stimulate and create grower interest in seed production, and through Professor Milward's further efforts the Wisconsin Potato Growers' Association was organized in 1912 to provide an agency through which his seed improvement work could be conducted. This group emphasized the production by members of standard varieties true to name and type and through selection and inspection guard against tuber borne diseases. To identify the seed they produced in 1913, the Association adopted a copyrighted trade-mark for their tags. As far as is known this was the first attempt to identify seed stocks produced and inspected under a set of qualified conditions in this country. To complete the picture, Professor Milward was also engaged in other activities of constant usefulness to the industry in developing exhibits and shows and a special train to carry the exhibits and demonstrations to many parts of the state.

Several other significant developments occurred in 1913 that were to influence the immediate and future pattern seed improvement work was to take. Professor Milward and Professor L. R. Jones of the Department of Plant Pathology had been working in close cooperation on the disease problems as they related to the varietal improvement work Professor Milward was doing. Although both men were quite conscious of the practicability of including disease standards in the program, information on many of the tuber borne diseases was quite meager at the time.

It was fortunate at this point that Dr. W. A. Orton of the United States Department of Agriculture and one of Professor Jones' students, when he was still in Vermont, came to Wisconsin and discussed a study trip on potatoes

he had made in Europe a few months previously. Dr. Orton explained the seed inspection program under the direction of Dr. Appel in Germany and discussed the importance of accurate field diagnoses and identification of many of the diseases.

Still added interest was given the disease problem by the Federal Quarantine considerations being given powdery scab and black wart, two tuber borne diseases known to be widely distributed in Europe and also known to have been introduced to this continent. The resulting embargo on all European and Canadian potatoes served to emphasize, among other things, the local need for an organized and systematic program of inspection. In this general atmosphere early in 1913 and after several conferences held in Dean H. L. Russell's office, it was decided that an official seed certification program be formed along the lines suggested by Dr. Orton and that Professor Milward be placed in charge of it as a member of the Horticulture Department of the University. As a staff member he was officially responsible for the seed inspection program and as Secretary of the Association he was affiliated with an agency representing all segments of the industry to complete a very practical and workable arrangement.

Pure seed problems was the chief topic of the 1913 Association Convention and several papers were presented on this subject keynoted by Dean H. L. Russell's on "the significance of pure seed work in Wisconsin." A second paper by Professor William Stuart of the United States Department of Agriculture on "seed selection and improvement in relation to commercial standards" and another by Dr. W. A. Orton on "official inspection and certification of potato seed stocks" were followed by Professor L. R. Jones' paper on "potato diseases in relation to the seed trade" to complete what was up to this moment the most comprehensive report made on seed improvement in the country. The Association was quick to appreciate the significance of the various reports, for they immediately adopted a resolution in support of the principle of developing a formal certification plan by the University rather than the program operated by the Association. Field and bin inspections were then made in 1914 under the plan that was developed by the University. Official seed grades were adopted shortly after 1917 when the Federal Foods Products Inspection Law was enacted. In general the seed grades followed the standards relating to the quality, size, and condition of table potatoes included in this law.

In reviewing the literature concerned with the early development of potato production in Wisconsin, it was quite evident that several competent leaders exercised sound judgment in appraising the needs of a rapidly growing industry. Potato certification was a direct and practical solution to many of these needs and it continues today as a service as sound in principle as it was then. As a matter of fact few changes have been necessary except that the knowledge gained from research, particularly in plant pathology, has strengthened the program immeasurably. In many ways several men have from time to time in the past made their contribution to certification work. Professor J. C. Walker who remained at Wisconsin in the Department of Plant Pathology was the first inspector trained in plant disease work to make field inspections. After the first season he was succeeded by Mr. J. W. Brann who remained with Professor Milward for several years. Many other men in various departments of the University have also made valuable contributions from time to time as have the many growers in the industry.

One of the papers on the Early History of Seed Certification in North America.

CERTIFIED SEED POTATO ACREAGE 1955

The 1955 acreage of Certified Seed in 26 states totals 131,042 acres based on reports obtained from the state certification agencies. This acreage compares with 137,078 acres harvested in 1954.

The Katahdin variety leads again for the ninth consecutive year followed by Russet Burbank which has replaced the Irish Cobbler as the second most popular variety in the U. S. Other leading varieties are Red Pontiac, Kennebec, White Rose, Bliss Triumph, Cherokee, Chippewa and Sebago.

The leading state is Maine followed by Minnesota, North Dakota, California, Nebraska, Wisconsin and Colorado in the order named.

The acreage by states is presented in table 1 and acreage by varieties in table 2.

Table 1

Certified Seed Potato Acreage by States, 1955, with Comparisons

State	Average 1943-52	1954	1955
Maine	48,853	52,723	43,724
Minnesota	21,763	25,172	23,715
North Dakota	29,754	19,233	19,503
Idaho	7,425	9,086	12,349
California	5,932	4,527	4,182
Nebraska	7,197	4,328	3,827
Wisconsin	4,149	3,071	3,812
Colorado	4,002	3,650	3,698
Oregon	2,920	2,706	2,979
New York	3,560	2,107	2,657
South Dakota	4,292	1,893	2,193
Montana	1,939	2,216	2,184
Michigan	2,511	1,801	1,995
Washington	1,340	1,374	1,582
Utah	670	777	713
Pennsylvania	1,050	892	453
Wyoming	1,551	401	392
Vermont	449	486	356
New Mexico	9	0	240
Tennessee	286	215	126
North Carolina	210	151	123
Iowa	128	72	122
New Jersey	232	108	101
New Hampshire	86	29	8
Virginia	4	4	4
Maryland	138	44	4
United States	145,431	137,078	131,042

Table 2

Acreage of Certified Seed Potatoes by Varieties, 1955

KATAHDIN	
Maine	29,567
New York	1,100
Pennsylvania	351
Michigan	275
Vermont	218
Wisconsin	168
Colorado	91
New Jersey	65
Minnesota	18
Oregon	6
Montana	2
Washington	2
Total	31,863

RUSSET BURBANK (NETTED GEM)	
Idaho	11,984
Maine	3,906
Montana	1,908
Minnesota	1,765
Oregon	1,602
California	1,179
Colorado	788
Washington	664
Wisconsin	573
North Dakota	315
Utah	118
Wyoming	74
New Mexico	50
Michigan	27
Vermont	8
Nebraska	6
New York	4
Total	24,971

RED PONTIAC	
North Dakota	11,769
Minnesota	6,205
Wisconsin	699
South Dakota	620
Colorado	604
Wyoming	143
California	142
Nebraska	96
New York	66
Washington	55
Iowa	55
Pennsylvania	54
Idaho	49
New Mexico	40
Montana	36
Oregon	17
Total	20,650

IRISH COBBLER	
Minnesota	9,719
Maine	3,337
North Dakota	1,846
South Dakota	230
Wisconsin	80
New York	76
Colorado	67
Iowa	24
Michigan	15
New Jersey	8
Pennsylvania	5
Maryland	4
Oregon	4
Vermont	2
Total	15,417

WHITE ROSE	
California	2,491
Oregon	1,062
Washington	738
Utah	587
North Dakota	559
Montana	160
Minnesota	120
Idaho	112
New Mexico	50
Colorado	20
Nebraska	15
Wisconsin	1
Total	5,915

KENNEBEC	
Maine	2,194
Minnesota	1,252
North Dakota	637
California	370
Wisconsin	198
New York	159
Idaho	130
Oregon	130
South Dakota	111
Washington	82
Nebraska	18
North Carolina	18
Iowa	13
Utah	8
Pennsylvania	5
Tennessee	5
New Jersey	4
Montana	3
New Hampshire	1
Total	5,338

Table 2 (Continued)

BLISS TRIUMPH	
North Dakota	2,009
Nebraska	1,202
Minnesota	974
South Dakota	339
Wyoming	86
Montana	75
Colorado	73
Oregon	61
Maine	60
New Mexico	50
Idaho	29
Wisconsin	3
Washington	1
Total	4,962

CHEROKEE	
Maine	1,493
Minnesota	847
Michigan	199
North Dakota	122
Wisconsin	112
New York	94
South Dakota	38
Vermont	15
Iowa	15
Oregon	6
Total	2,941

CHIPPEWA	
Maine	1,458
Wisconsin	401
New York	241
Michigan	80
Minnesota	53
New Jersey	21
Idaho	2
Oregon	1
Total	2,257

SEBAGO	
Michigan	660
Wisconsin	651
New York	371
Maine	276
Minnesota	178
North Dakota	61
Pennsylvania	12
Total	2,209

LA SODA	
Nebraska	920
South Dakota	479
North Dakota	366
Minnesota	195
Wisconsin	46
Colorado	24
Wyoming	24
Total	2,054

RED McCLURE	
Colorado	1,566
New Mexico	50
Wisconsin	22
Total	1,638

RUSSET RURAL	
Michigan	597
New York	300
Colorado	281
Maine	228
Wisconsin	113
Pennsylvania	25
Total	1,544

EARLY GEM	
North Dakota	1,085
Wisconsin	81
Minnesota	53
Colorado	48
Idaho	42
Nebraska	39
Wyoming	33
South Dakota	17
Oregon	3
Montana	0.1
Total	1,399.1

EARLY OHIO	
Minnesota	597
North Dakota	323
South Dakota	57
Total	977

GREEN MONTAIN	
Maine	778
Vermont	93
New York	29
Michigan	18
Minnesota	17
New Hampshire	4
Wisconsin	2
Total	941

RED TRIUMPH	
Minnesota	695
Tennessee	100
Wisconsin	1
Wyoming	4
Total	800

RED WARBA	
Minnesota	316
North Dakota	188
Wisconsin	77
Nebraska	41
Colorado	15
Total	637

Table 2 (Continued)

PROGRESS	
Nebraska	560
Wyoming	4
Colorado	2
Total	566

RED LA SODA	
South Dakota	192
Wisconsin	139
Nebraska	59
Minnesota	6
North Dakota	4
Total	400

WASECA	
Minnesota	358
North Dakota	2
Wisconsin	1
Total	361

ONTARIO	
New York	145
Wisconsin	94
Maine	93
Total	332

DAZOC	
Nebraska	254
Colorado	57
North Dakota	2
Total	313

RUSSET SEBAGO	
Wisconsin	296

RED KOTE	
Minnesota	200
North Dakota	59
South Dakota	20
Iowa	15
Wisconsin	1
Total	295

SEQUOIA	
North Carolina	90
Michigan	56
Maine	29
Tennessee	21
Wisconsin	1
Total	197

CAYUGA	
Nebraska	174

REDGLO	
Nebraska	187
Wyoming	20
Colorado	10
Total	217

SHERIDAN	
Nebraska	158
Wisconsin	5
Wyoming	4
Colorado	2
Total	169

TETON	
Maine	166

REDBURT	
Minnesota	105
South Dakota	18
Wisconsin	2
Total	125

RED SPORT TRIUMPH	
North Dakota	123

PONTIAC	
Washington	36
Maine	33
New York	24
Michigan	22
Oregon	5
Total	120

RURAL NEW YORKER (same as White Rural or Smooth Rural)	
Michigan	46
New York	29
Colorado	12
Total	87

WHITE CLOUD	
Nebraska	63
Colorado	12
South Dakota	3
Total	78

BURBANK	
Oregon	78

PUNGO	
Maine	68
New Jersey	3
Total	71

Table 2 (Continued)

RUSHMORE	
South Dakota	69
Minnesota	0.4
Total	69.4
PAWNEE	
Wisconsin	22
HOUMA	
Vermont	20
New Hampshire	2
Total	22
WARBA	
Maine	18
Pennsylvania	1
Minnesota	0.5
Total	19.5
CANSO	
Maine	17
Wisconsin	1
Total	18
ESSEX	
New York	7
North Carolina	7
Virginia	4
Total	18
DE SOTA	
Colorado	16
KESWICK	
Minnesota	7
Wisconsin	5
Colorado	2
Total	14
CANOGA	
New York	12
OSAGE	
Minnesota	11
Wisconsin	0.5
Total	11.5
EARLY ROSE	
Washington	4
Oregon	4
Maine	0.1
Total	8.1
COLUMBIA RUSSET	
Minnesota	8
BOONE	
North Carolina	8
N311	
Colorado	7
ANTIGO	
Wisconsin	6
YAMPA	
Minnesota	3
Colorado	3
Total	6
SACO	
Maine	2
Minnesota	1
Total	3
RED BEAUTY	
Wisconsin	3
MERRIMACK	
Maine	1
New Hampshire	0.5
Minnesota	0.1
Total	1.6
OSSEO	
Minnesota	1
NEW WHITE	
Minnesota	0.5
EXCELS	
Vermont	52 Units
MISC. & SEEDLINGS	
North Dakota	35
Wisconsin	7
Total	42

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from your Grower, Dealer or Shipper

STATE SEED DEPARTMENT

COLLEGE STATION FARGO, N. D.

SEED CERTIFICATION IN NORTH DAKOTA

The popularity of North Dakota Certified Seed Potatoes throughout the country is not just a happenstance. It is the result of numerous, industrious farmers working diligently under a very strict certification system to produce for customers the best certified seed possible.

It is true that soil and other environmental factors favor such a development. The State is located in the geographic center of the continent next to the Canadian Border and has plenty of wide-open, fertile, dry-land prairies on which to develop and grow seed potatoes. Western North Dakota is an ideal area to develop and practice foundation seed stocks. The eastern portion of the State with higher average rainfall is ideal for volume production. Even though geographic location, soil, open prairies and other environmental factors are favorable, the best of seed cannot be produced continuously without effort and foresight by everyone concerned.

Red Pontiac, Kennebec, Cherokee, Redhote, Early Gem and other new varieties are maintained free of virus X and other viruses. Any certified potato grower may request small quantities of this virus free seed. Most of this stock has been given to western North Dakota growers for isolated increase in units and tuber lines. These increases are tested (sometimes with continued tuber indexing) in our greenhouse and south Florida test plot. Ordinarily, the result is a perfect lot of seed ready for volume production. Not until this stock develops its first virus plant does it ordinarily start its way out of certification. The certified history of such stocks vary greatly. Some in diligent hands may be kept practically clean for many seasons. Other stocks less intelligently handled may last only two or three seasons.

To safeguard and maintain an accurate picture of each and every lot, besides continuous summer inspections, large samples are tested each winter in South Florida. On about October 11th a large carload of 1000 tuber samples representing each lot to be planted for certification next season is shipped to our southern testing ground. On about November 10 to 15th they are planted in tuber units. Complete and very accurate readings start December 20th and are completed about February 10th. North Dakota growers have a chance to change seed stocks if their own proves marginal or ineligible in southern tests.

To maintain eligibility for final certification, all stocks must be harvested and stored in a clean and sanitary manner.

All shipments of certified seed must be Federal-State Inspected and meet the special requirements for North Dakota Certified Seed Grades.

POTATOES – AN INEXPENSIVE SOURCE OF DIETARY NEEDS

Potatoes constitute an economical source of many essential nutrients. In the spring of 1948, two per cent of the food dollar was used for potatoes but the returns in nutritive value were much higher especially in ascorbic acid, niacin, thiamine, and iron. After allowance was made for average cooking losses, potatoes contributed about 11 per cent of the total vitamin C (ascorbic acid) content of family diets and six per cent of total thiamine and niacin (both are B-vitamins). While potatoes are considered a high calorie food by many people, actually the per cent of total calories derived from potatoes in family diets is relatively low — 3.2 per cent in the spring of 1948.

BUYER'S GUIDE

Manufacturers or distributors of supplies and equipment for the Potato Industry.

Names in **Bold Type** indicate that the company has an advertisement in this book.

BAGS (Burlap)

Bemis Bros. Bag Co.
St. Louis 2, Mo.

Berg Bag Co.
410 3rd Ave. North,
Minneapolis 1, Minn.

Chase Bag Co.
Milwaukee, Wis.

Fulton Bag & Cotton Mills,
Minneapolis 13, Minn.

Maine Potato Growers, Inc.
Presque Isle, Maine

BAGS (Paper)

Bemis Bros. Bag Co.
St. Louis 2, Mo.

Chase Bag Co.
Milwaukee, Wis.

Continental Can Company
Shellmar-Betner Flexible Packaging Div.
Mt. Vernon, Ohio

Equitable Paper Bag Co.
Long Island City 1, N. Y.

Hammond Bag and Paper Co.
Wellsburg, W. Va.

Oneida Paper Products
Clifton, N. J.

Union Bag & Paper Corp.
Woolworth Bldg., New York 7, N. Y.

BAGS (Polyethylene)

American Viscose Corp.
Philadelphia, Pa.

Ames Bag Co.
Selma, Ala.

The Bakelite Co.
30 E. 42nd Street
New York 17, N. Y.

Celanese Corp. of America
Plastics Division
290 Ferry Street
Newark 5, N. J.

Champion Bag Co.
160 N. Loomis St.,
Chicago, Ill.

Dixie Wax Paper Company
Washington, N. J.

E. I. duPont de Nemours & Co., Inc.
Wilmington, Del.

Durethene Corp.
5600 W. Arbor Vitae St.
Los Angeles 45, Calif.

Equitable Paper Bag Co., Inc.
Long Island City 1, N. Y.

Kennedy Car Liner & Bag Co., Inc.
Shelbyville, Ind.

Milprint Inc.
Milwaukee 1, Wis.

Olin Film Div.
Olin Mathieson Chemical Corp.
Baltimore, Md.

The Visking Corp., Plastics Div.
Terre Haute, Ind.

BAG CLOSERS & SEALERS

Aeroglide Corp.
510 Glenwood Ave.
Raleigh 1, N. C.

Bostitch
Waverly, R. I.

Doughby Industries, Inc.
New Richmond, Wis.

Food Machinery Corp.
Lakeland, Fla.

The Hamer Machine Co.
Minneapolis, Minn.

Lockwood Grader Corp.
Gering, Nebr.

Minnesota Mining & Mfg. Co.
St. Paul, Minn.

Mystic Adhesive Products
Chicago 39, Ill.

Permacel Tape Co.
New Brunswick, N. J.

J. H. Platt & Son
1202 E. Seauson Ave.
Los Angeles 11, Calif.

The Trescott Company, Inc.
Fairport, N. Y.

BAG HOLDERS & FILLING EQUIPMENT

K. G. Brown Mfg. Co.
Mattituck, N. Y.

Westervelt Company
Box 251
Downers Grove, Ill.

BAG LOADERS

Boggs Mfg. Co.
Atlanta, N. Y.

Paramount Mfg. Co.
1615 East Maine St.
Stockton, Calif.

Singer Mfg. Co.
Smithville, Ohio

Troyer Mfg. Co.
Box 308
Smithville, Ohio

BIN UNLOADERS

Boggs Mfg. Co.
Atlanta, N. Y.

Lockwood Grader Corp.
Gering, Nebr.

BOXES (Palleted for potatoes)

General Box Co.
1825 Miner St.
Des Plaines, Ill. and
Denville, N. J.

Lockwood Grader Corp.
Gering, Nebr.

CAR FLOOR PADS

American Excelsior Corp.
1000 N. Halsted St.
Chicago 22, Ill.

Jiffy Mfg. Co.
360 Florence Ave.
Hillside, N. J.

CAR AND TRUCK HEATERS

Siebring Mfg. Co.
George, Iowa

Western Metal Specialty Co.
N. 62nd St.
Milwaukee, Wis.

CONVEYORS

Aeroglide Corp.
510 Glenwood Ave.
Hillside, N. J.

Boggs Mfg. Co.
Atlanta, N. Y.

Dual Mfg. & Sales Co.
293 N. Snelling Ave.
St. Paul 4, Minn.

Lockwood Grader Corp.
Gering, Nebr.

Oliver Corp.,
400 West Madison St.
Chicago 6, Ill.

Paramount Mfg. Co.
1615 East Main St.
Stockton, Calif.

Singer Mfg. Co.
Smithville, Ohio

The Trescott Co., Inc.
Fairport, N. Y.

Troyer Mfg. Co.
Box 308
Smithville, Ohio

CUTTERS

Lockwood Grader Corp.
Gering, Nebr.

Singer Mfg. Co.
Smithville, Ohio

Albert E. Trexler
P. O. Lenhartsville, Pa.

Troyer Mfg. Co.
Box 308
Smithville, Ohio

DIGGERS

Agricultural Implement Division
321 West O St.
Lincoln, Nebr.

Deere & Co., Dept. 106A
Moline, Ill.

International Harvester Co.
Harvester Bldg.
Chicago, Ill.

Lockwood Grader Corp.
Gering, Nebr.

Oliver Corp.,
400 West Madison St.
Chicago 6, Ill.

DRYERS

Aeroglide Corp.
510 Glenwood Ave.
Raleigh 1, N. C.

John Bean Division,
Lansing, Mich.

Lockwood Grader Corp.
Gering, Nebr.

Paramount Mfg. Co.
1615 East Main St.
Stockton, Calif.

Seibring Mfg. Co.
George, Iowa

FERTILIZERS

American Agricultural Chem. Corp.
Carteret, N. J.

American Cyanamid Co.
30 Rockefeller Plaza
New York 20, N. Y.

International Minerals and Chem. Corp.
20 No. Wacker Drive
Chicago 6, Ill.

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Chemical Sales Div.
El Dorado, Ark.

Nitrogen Division
Allied Chemical & Dye Corp.
New York 6, N. Y.

Summers Fertilizer Co.
604 Stock Exchange Bldg.
Baltimore 2, Md.

Tennessee Corp.
619 Grant Bldg.
Atlanta 1, Ga.

FUNGICIDES

California Spray Chemical Corp.
Richmond, Calif.

Chemical Insecticide Corp.
129 Montague St.
Brooklyn 1, N. Y.

E. I. duPont de Nemours Corp.
Wilmington, Del.

General Chemical Division
Allied Chemical & Dye Corp.
40 Rector St.
New York 6, N. Y.

Hastings & Sons Ltd.
200 McPhillips St.
Winnipeg, Man., Canada

Phelps Dodge Refining Corp.
300 Park Ave.
New York 22, N. Y.

Rohm & Haas Co.
Washington Square
Philadelphia 5, Pa.

Stauffer Chemical Co.
380 Madison Ave.
New York 14, N. Y.

Tennessee Corp.
619 Grant Bldg.,
Atlanta 1, Ga.

Thompson Chemicals Corp.
3028 Locust St.
St. Louis 3 ,Mo.

U. S. Rubber Co.
Naugatuck Chem. Div.
Naugatuck, Conn.

GRADERS & SORTERS

Aeroglide Corp.
510 Glenwood Ave.
Raleigh 1, N. C.

John Bean Division
Lansing ,Mich.

Boggs Mfg. Co.
Atlanta, N. Y.

Lockwood Grader Corp.
Gering, Nebr.

Paramount Mfg. Co.
1615 East Main St.
Stockton, Calif.

Tew Mfg. Corp.
Fairport, N. Y.

The Trescott Co., Inc.
Fairport, N. Y.

Troyer Mfg. Co.
Box 308, Smithville, Ohio

HARVESTERS

Agricultural Implement Division
321 West O Street
Lincoln, Nebr.

Champion Corp.
Hammond, Ind.

Dual Mfg. & Sales Co.
St. Paul 4, Minn.

John Bean Division
Lansing, Mich.

Lockwood Grader Corp.
Gering, Nebr.

Noffsinger Mfg. Co.
Greeley, Colo.

Paramount Mfg. Co.
1615 East Main St.
Stockton, Calif.

IRRIGATION EQUIPMENT

Aluminum Co. of America
Pittsburgh 19, Pa.

W. R. Ames Co.
150 Hooper St.
San Francisco 7, Calif.
and
Broadway
Tampa, Fla.

Buckner Mfg. Co. (Sprinklers)
Fresno, Calif.

California Corrugated Culvert Co.
Berkely 2, Calif.

Carver Pump Co.
Muscatine, Iowa

Champion Corp.
Hammond, Ind.

Chicago Metal Mfg. Co.
Chicago 32, Ill.

Fairbanks-Morse & Co.
3601 Kansas Ave.
Kansas City, Kansas

Food Machinery & Chem. Corp.
Lakeland, Fla.

Gorman Rupp Co.
Mansfield, Ohio

Hale Fire Pump Co.
Conshohocken, Pa.

Johns-Manville Corp.
Box 60
New York 16, N. Y.

March Automatic Irrigation Co.
Muskegon, Mich.

Marlow Pumps
Ridgewood, N. J.

Olin Mathieson Chemical Corp.
Mathieson Bldg.
Baltimore, Md.

Reynolds Metals Co.
P. O. Box 1800
Louisville, Ky.

R. M. Wade & Co.
1919 N. W. Thurman St.
Portland 9, Oregon

INSECTICIDES

California Spray Chemical Corp.
Richmond, Calif.

Chemical Insecticide Corp.
129 Montague St.
Brooklyn 1, N. Y.

Geigy Agricultural Chemicals
Division of Geigy Chemical Corp.
89 Barclay St.
New York 8, N. Y.

General Chemical Division
Allied Chemical & Dye Corp.
40 Rector St.
New York 6, N. Y.

Lebanon Chemical Corp.
Box 532
Lebanon, Pa.

INSECTICIDES *(Cont.)*

Maine Potato Growers, Inc.
Presque Isle, Maine

Olin Mathieson Chemical Corp.
Mathieson Bldg.
Baltimore 3, Md.

John Powell & Co., Inc.
One Park Ave.
New York 16, N. Y.

Pennsylvania Salt Mfg. Co.
1000 Widener Bldg.
Philadelphia 7, Pa.

Pittsburgh Coke & Chemical Co.
Agri. & Chem. Division
Grant Bldg.
Pittsburgh 30, Pa.

Rohm & Haas Co.
Washington Square
Philadelphia 5, Pa.

Stauffer Chemical Co.
380 Madison Ave.
New York 14, N. Y.

Thompson Chemicals Corp.
3028 Locust St.
St. Louis 3, Mo.

U. S. Rubber Co.
Naugatuck Chemical Division
Naugatuck, Conn.

Velsicol Corp.
33 East Grand Ave.
Chicago 11, Ill.

PICKERS & BAGGERS

Arno Schmechel & Son, Inc.
Thiensville, Wis.

Paramount Mfg. Co.
1615 East Main St.
Stockton, Calif.

PLANTERS

Deere & Co.
Moline, Ill.

Oliver Corp.,
400 West Madison St.
Chicago 6, Ill.

International Harvester Co.
Harvester Bldg.
Chicago, Ill.

RESPIRATORS (Dust Masks)

Doggett-Pfeil Co.
Springfield, N. J.

Farm Bureau Cooperative Assn.
254 N. High St.
Columbus, Ohio

Mine Safety Appliances Co.
Braddock Ave. & Thomas Blvd.
Pittsburgh 8, Pa.

Andrew Wilson Co.
Springfield, N. J.

SCALES

Exact Weight Scale Co.
944 West Fifth Ave.
Columbus 12, Ohio

SEED TREATING EQUIPMENT

Paramount Mfg. Co.
1615 E. Main St.
Stockton, Calif.

SPRAYERS & DUSTERS

Agricultural Equipment Co., Inc.
Gowanda, N. Y.

John Bean Division
Lansing, Mich.
Brown Manly Plow Co.
Malta, Ohio

Dobbins Mfg. Co.
Elkhart, Ind.

Frost Insecticide Co.
Arlington 74, Mass.

The Hardie Mfg. Co.
Hudson, Mich.

H. D. Hudson Mfg. Co.
589 E. Illinois St.
Chicago, Ill.

Messinger Mfg. Co.
Tatamy, Pa.

The F. E. Myers & Bro. Co.
Ashland, Ohio

Niagara Chemical Div.
Food Machinery & Chem. Corp.
Middleport, N. Y.

The Oliver Corp.
400 W. Madison St.
Chicago 6, Ill.

Andrew Wilson Co.
Springfield, N. J.

SPROUT INHIBITORS

General Chem. Division
Allied Chem. & Dye Corp.
40 Rector St.
New York 6, N. Y.

SPROUT INHIBITORS *(Cont.)*

Lockwood Grader Corp.
Gering Nebr.

Naugatuck Chemical Co.
Naugatuck, Conn.

Sterwin Chemicals, Inc.
1450 Broadway
New York, N. Y.

Thompson Chemicals Corp.
3028 Locust St.
St. Louis 3, Mo.

STEAM CLEANERS FOR DISINFECTING

John Bean Division
Lansing, Mich.

Seibring Mfg. Co.
George, Iowa

TAGS

Dennison Mfg. Co.
Farmingham, Mass.

VINE & WEED KILLERS (Chemical)

Chemical Insecticide Corp.
129 Montague St.
Brooklyn 1, N. Y.

Chipman Chemical Co., Inc.
Bound Brook, N. J.

The Dow Chemical Co.
Midland, Mich.

E. I. duPont de Nemours & Co., Inc.
Wilmington, Del.

Geigy Chemical Corp.
89 Barclay St.
New York 8, N. Y.

General Chemical Division
Allied Chemical & Dye Corp.
40 Rector St.
New York 6, N. Y.

Lebanon Chemical Corp.
Box 532
Lebanon, Pa.

Lockwood Grader Corp.
Gering, Nebr.

Pennsylvania Salt Mfg. Co.
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Ford Motor Co., Tractor Div.
Dearborne, Mich.

Lockwood Grader Corp.
Gering, Nebr.

Wood Bros. Mfg. Co.
Oregon, Ill.

WASHERS

Aeroglide Corp.
510 Glenwood Ave.
Raleigh 1, N. C.

John Bean Division
Lansing, Mich.

Florida Division
Food Machinery & Chemical Corp.
Lakeland, Fla.

Lockwood Grader Corp.
Gering, Nebr.

Paramount Mfg. Co.
1615 E. Main St.
Stockton, Calif.

Tew Mfg. Corp.
Fairport, N. Y.

WAXERS

Aeroglide Corp.
510 Glenwood Ave.
Raleigh 1, N. C.

John Bean Division
Lansing, Mich.

S. C. Johnson & Son, Inc.
Racine, Wis.

Paramount Mfg. Co.
1615 E. Main St.
Stockton, Calif.

Tew Mfg. Corp.
Fairport, N. Y.

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All Varieties Available

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